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VOL. XXXVII JANUARY 1939 No. 1

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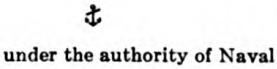
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NAVY DEPARTMENT,
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TRUMAN H. NEWBERRY,
Acting Secretary.

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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, and reports from various sources, notes, and comments on topics of medical interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T. McINTIRE,
Surgeon General, United States Navy.

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized.

The BULLETIN intends to print only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.

EBEN E. SMITH, *Editor,*
Commander, Medical Corps, United States Navy.

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U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVII JANUARY 1939 NO. 1

SPECIAL ARTICLES

SURGICAL SHOCK [1]

By Lt. Comdr. HOWARD K. GRAY, Medical Corps, United States Naval Reserve, and LESTER R. CHAUNCEY, M. D., Fellow in Surgery, the Mayo Foundation

Since the year 1795, when James Latta first introduced the term SHOCK, numerous hypotheses have been advanced in an attempt to explain this condition. It must be admitted that all the factors concerned in the production of shock are not understood fully, yet an understanding of the established physiologic bases for present day hypotheses regarding shock is essential to the surgeon on whom may rest the responsibility of dealing with this condition. The more recent hypotheses have arisen largely from the clinical experience of the Great War and from subsequent investigative work.

Excellent detailed historical résumés of the subject have been presented by Blalock [2-4] and by Moon.[5 6] Those who are interested in this aspect of the subject are referred to these articles.

In 1863, Goltz [7] produced a condition known now as PRIMARY SHOCK. He noted that repeated blows on the viscera of a suspended frog produced a great fall in blood pressure because of stimulation of the vagus nerve which slowed cardiac action, and because of vasodilatation which was thought to be especially extensive in the splanchnic region. To this conception that shock is due to circulatory collapse through loss of vascular tone, nothing has been added by recent investigators.

Secondary shock, surgical shock, or traumatic shock must be distinguished from the condition of primary shock or collapse. One distinction depends essentially on the length of the interval between the injury and occurrence of shock. In cases of primary shock, a

[1] From the Division of Surgery, the Mayo Clinic, Rochester, Minn.

[2] Blalock, Alfred: Experimental shock; the cause of the low blood pressure produced by muscle injury. Arch. Surg., 20: 959–996 (June) 1930.

[3] Blalock, Alfred: Experimental shock. VI. The probable cause for the reduction in the blood pressure following mild trauma to an extremity. Arch. Surg., 22: 598–609 (April) 1931.

[4] Blalock, Alfred: Acute circulatory failure as exemplified by shock and haemorrhage. Surg., Gynec. & Obst., 58: 551–566 (March) 1934.

[5] Moon, V. H.: The shock syndrome in medicine and surgery. Ann. Int. Med., 8: 1633–1638 (June) 1935.

[6] Moon, V. H.: Shock, its mechanism and pathology. Arch. Path., 24: 642–663 (November) 1937.

[7] Goltz, Fr.: Ueber den tonus der Gefässe und seine Bedeutung für die Blutbewegung. Virchows Arch. f. path. Anat., 29: 394–432, 1864.

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fall in blood pressure and the appearance of other symptoms follow the injury immediately, whereas in cases of secondary shock, the symptoms appear, usually, 1 to 4 hours after the injury. Physiologically, the basic difference is the loss of blood volume associated with secondary shock whereas such a loss does not occur in connection with primary shock. The hypotheses advanced to explain secondary shock have been those concerned with exhaustion, fat embolism, acidosis, acapnia, toxemia, and loss of fluid locally from the tissues.

Hypotheses Regarding the Cause of Secondary Shock

Exhaustion.—That the ultimate result of stimulation of nerves would be fatigue and inhibition of the vital centers was advanced by Groeningen [8] as the basic cause of secondary shock. Crile,[9] [10] in present day literature, concluded that prolonged stimulation resulted in exhaustion of the vasomotor center with resultant arterial relaxation. He stressed many factors concerned, such as fear, emotional disturbances, and crude surgical technic such as rough handling of the viscera, and so forth. The clinical application of this principle in the operating room today, with eradication of these factors from operative technic as far as possible, has resulted in a great decrease in the incidence of postoperative shock. However, the hypothesis itself was invalidated when it was shown by Erlanger [11-16] and others that the phenomenon of secondary shock is associated with vasoconstriction and not with vasodilation. Mann,[17] in 1914, also noted evidence of vasomotor activity among shocked animals and failed to produce shock by excessive sensory stimulation.

Fat embolism.—Associated with the hypothesis that fat emboli cause shock are the names of Groeningen,[8] Warthin,[18] and Porter.[19]

[8] Groeningen, G. H.: Ueber den Shock. Eine kritische Studie auf physiologischer Grundlage. Weisbaden, J. F. Bergmann, 1885, 255 pp.

[9] Crile, G. W.: An experimental research into surgical shock. Philadelphia, J. B. Lippincott Co., 1897, 160 pp.

[10] Crile, G. W.: Hemorrhage and transfusion. New York, D. Appleton & Co., 1909, 560 pp.

[11] Erlanger, Joseph, Gessell, Robert, and Gasser, H. S.: Studies in secondary traumatic shock. I. The circulation in shock after abdominal injuries. Am. J. Physiol., **49**: 90–116 (June) 1919.

[12] Erlanger, Joseph, and Gasser, H. S.: Studies in secondary traumatic shock. II. Shock due to mechanical limitations of blood flow. Am. J. Physiol., **49**: 151–173 (July) 1919.

[13] Erlanger, Joseph, and Gasser, H. S.: Studies in secondary traumatic shock. III. Circulatory failure due to adrenalin. Am. J. Physiol., **49**: 345–376 (August) 1919.

[14] Gasser, H. S., Erlanger, Joseph, and Meek, W. J.: Studies in secondary traumatic shock. IV. The blood volume changes and the effect of gum acacia on their development. Am. J. Physiol., **50**: 31–53 (October) 1919.

[15] Gasser, H. S., and Erlanger, Joseph: Studies in traumatic shock. V. Restoration of the plasma volume of the alkali reserve. Am. J. Physiol., **50**: 104–118 (October) 1919.

[16] Erlanger, Joseph, and Gasser, H. S.: Studies in secondary traumatic shock. VI. Statistical study of the treatment of measured trauma with solutions of gum acacia and crystalloids. Am. J. Physiol., **50**: 119–147 (October) 1919.

[17] Mann, F. C.: The peripheral origin of surgical shock. Bull. Johns Hopkins Hosp., **15**: 205–212 (July) 1914.

[18] Warthin, A. S.: Traumatic lipaemia and fatty embolism. Internat. Clin., **4**: 171–227, s. 23, 1913.

[19] Porter, W. T.: Fat embolism shock is not explained by embolism of the lungs. Boston M. & S J., **129**: 531–532 (May 8) 1919.

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Shock associated with extensive injury, particularly that of the long bones, presumably might be caused by pulmonary fat emboli. Porter emphasized that fat emboli in the vasomotor region could cause the shock observed following the experimental, intravenous injection of olive oil and thick creams into cats. However, as a basic hypothesis, this is found wanting when one considers the innumerable ways in which shock may be produced when fat has not been traumatized. Moon [5] [6] and his associates were unable to demonstrate stainable fat in the capillaries of experimental animals when shock was produced by various conditions.

Acidosis.—Although a decrease in the reserve of alkali accompanies shock, this phenomenon is evidently an effect rather than a cause. Shock is not prevented even when the reserve of alkali is maintained by intravenous injection of sodium bicarbonate. This reserve may be lowered by the intravenous injection of lactic acid and, in the absence of other factors, shock-like symptoms will not result. The explanation has been advanced by Moon that the decrease in the reserve of alkali is due to a deficient circulation and to anoxemia, which produce incomplete metabolism with the formation of excessive acid radicals.

Acapnia.—The hypothesis regarding acapnia as a cause of shock was advanced by Henderson in 1908.[20] It is predicated on the supposition that excessive respiratory activity will so lower the content of carbon dioxide in the blood that adequate stimulation of the vasopressor center will be lost, and that cardiac output will be diminished and thereby will result in a diminished return of venous blood. Clinically and experimentally this concept has been shown to be inadequate. Repetition of experiments by Mann [17] has failed to show that shock results from hyperventilation and the maintenance of a high concentration of carbon dioxide in the blood has failed to prevent it. Experience during the Great War showed the lack of vigorous breathing among wounded individuals whose respirations, although they were sometimes rapid, were usually shallow. Cannon,[21] summarizing the evidence, spoke decidedly against this hypothesis. The statement he made that "shock may exist without acapnia and acapnia without shock" is often quoted.

Toxemia.—The hypothesis that toxins present in the blood cause shock, which arose from experience and investigative work of the Great War, and the hypothesis that loss of fluid from the tissues lo-

[5] Moon, V. H.: The shock syndrome in medicine and surgery. Ann. Int. Med., 8: 1633–1638 (June) 1935.

[6] Moon, V. H.: Shock, its mechanism and pathology. Arch. Path., 24: 642–663 (November) 1937.

[17] Mann, F. C.: The peripheral origin of surgical shock. Bull. Johns Hopkins Hosp., 15: 205–212 (July) 1914.

[20] Henderson, Yandell: Acapnia and shock I. Carbon-dioxid as a factor in the regulation of the heart rate. Am. J. Physiol., 21: 126–156 (Feb. 1), 1928.

[21] Cannon, W. B.: A consideration of possible toxic and nervous factors in the production of traumatic shock. Ann. Surg., 100: 704–713 (October), 1934.

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cally causes shock arising from Blalock's [2 4] work are what may be termed the modern day hypotheses. Both of these hypotheses are the result of an attempt to explain the decrease of the volume of blood that accompanies shock. This decrease in the volume of blood was noted by Keith [22] in 1919. He compared the condition of shock with that of hemorrhage in both of which conditions there is a decrease in the volume of blood and, further, he stressed the close relationship that existed between the decrease of the volume of blood and the severity of symptoms. Associated and correlated with these clinical observations were the experimental observations of Cannon and Bayliss.[23] These workers produced shock by traumatizing posterior limbs of anesthetized cats. This resulted in an early, rapid fall in blood pressure followed by a more gradual but continuous fall. At the time of postmortem examination there was an increase in the weight of the limbs to that of 10 percent of the total weight of the blood. The loss of blood into the tissues seemed to be insufficient to account for the decline in blood pressure.

Transection of the cord or severance of the nerves to the limb did not prevent shock and these observations led to the conclusion that nervous factors did not play a part in the production of secondary shock. On the other hand, ligation of the blood vessels seemed to prevent shock. Removal of the ligature with resumption of circulation was followed by a decrease in blood pressure presumably because of some depressant substance which had been liberated into the general circulation. A suggestion as to the nature of this substance was supplied by the work of Dale, Laidlaw, and Richards,[24] who produced shock by injecting histamine into etherized cats. This produced capillary dilatation and loss of fluid from the blood stream into the tissues.

This conception that a circulatory depressant is produced by trauma of muscle forms the basis of the hypothesis regarding toxemia as a cause of shock. Judging from the much-quoted reports of other war experiences, this hypothesis seemed to be borne out clinically. The fact that many men with multiple wounds of muscles died presumably from shock, and that shock was more likely to be associated with the deep poorly drained wounds than with the more extensive superficial ones, seemed to bear out this contention. Shock frequently became manifest immediately after removing a tourniquet and this experience

[2] Blalock, Alfred: Experimental shock; the cause of the low blood pressure produced by muscle injury Arch. Surg., 20: 959–996 (June) 1930.

[4] Blalock, Alfred: Acute circulatory failure as exemplified by shock and haemorrhage. Surg., Gynec. & Obst., 58: 551–566 (March) 1934.

[22] Keith, N. M.: Blood volume changes in wound shock and primary haemorrhage. Med. Res. Council, Special Report Series No. 27, pp. 2–16, 1919.

[23] Cannon, W. B., and Bayliss, W. M.: IV. Note on muscle injury in relation to shock. Med. Res. Council, Special Report Series No. 26, pp. 19–23, 1919.

[24] Dale, H. H., Laidlaw, P. P., and Richards, A. N.: II. The action of histamine; its bearing on traumatic toxemia as a factor in shock. Med. Res. Council, Special Report Series No. 26, pp. 8–15, 1919.

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led finally to the practice of leaving the tourniquet in place until amputation of the affected limb had been performed proximal to the tourniquet. It may be prudent to point out that much evidence may be advanced against such a hypothesis; yet, the practical applications arising from the observations on which the hypothesis was based should not be neglected.

Moon [5,6] recently has reviewed the experimental evidence in favor of the presence of depressant substances as a causative factor. It has been observed that injection of saline extracts of muscle causes prompt fall in blood pressure with hemoconcentration and loss of blood plasma. Similar results were obtained with extracts of intestinal mucosa and defibrinated blood. Recently, the possibility has been suggested that the basic causative principle was similar to adenosine, extracted from skeletal muscle, or to kallikrein. However, adenosine acts directly on arterioles and kallikrein is destroyed rapidly in normal serum. The hypothesis that histamine is the substance responsible for shock is objected to on the grounds that histamine dilates the arterioles in man. Even under the most favorable experimental conditions, the amount of histamine that could possibly be absorbed from the traumatized thigh would seem to be inadequate for the production of shock. Roome and Wilson [25] found that injection of extract of nontraumatized muscle invariably causes a rise in blood pressure, whereas a similar extract of traumatized muscle caused only slight toxic effects and did not cause sustained fall in blood pressure. The early conflicting reports were probably owing to the presence of both pressor and depressor substances in the extracts from muscle and to the presence of relatively greater proportions of either substance because of the different methods used in extraction.

To study further the hypothesis regarding the production of toxin at the site of trauma, other experiments were devised. All of these experiments need not be mentioned here, but many are of especial interest in view of previous contentions. Blood obtained from the femoral vein of a traumatized limb, if injected into another animal, would be expected to cause a fall in pressure. Blalock [2-4] found that it did not. In fact, if an animal's blood pressure was lowered because of hemorrhage, it was subsequently raised by injection of blood from the traumatized limb. These results are in agreement with those of

[2] Blalock, Alfred: Experimental shock; the cause of the low blood pressure produced by muscle injury. Arch. Surg., 20: 959-996 (June) 1930.

[3] Blalock, Alfred: Experimental shock. VI. The probable cause for the reduction in the blood pressure following mild trauma to an extremity. Arch. Surg., 22: 598-609 (April) 1931.

[4] Blalock, Alfred: Acute circulatory failure as exemplified by shock and haemorrhage. Surg., Gynec. & Obst., 58: 551-566 (March) 1934.

[5] Moon, V. H.: The shock syndrome in medicine and surgery. Ann. Int. Med., 8: 1633-1638 (June) 1935.

[6] Moon, V. H.: Shock, its mechanism and pathology. Arch. Path., 24: 642-663 (November) 1937.

[25] Roome, N. W., and Wilson, Harwell: Experimental shock: the effects of extracts from traumatized limbs on the blood pressure. Arch. Surg. 31: 361-370 (September) 1935.

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Smith,[26] published in 1928, and with those reported in 1935 by O'Shaughnessy and Slome.[27] These later authors carried out experiments in which the blood streams of two animals were separated only by a collodion membrane. Presumably, any toxins elaborated should cross this membrane. Trauma to the limb of one dog was not followed by a fall in the blood pressure of the other dog. The injection of histamine, however, produced a fall in the blood pressure of the other animal.

LOCAL LOSS OF FLUID.—Owing chiefly to the work of Blalock [2-4] and his collaborators, presented in 1930 and reviewed in 1934, the conception that the basis of traumatic shock is loss of fluid locally at the site of injury gained credence. As mentioned previously, Cannon and Bayliss [23] had traumatized limbs of animals and concluded that loss of fluid locally in the leg was not sufficient to account for the shock produced. Blalock, in repeating these experiments, noted that swelling of the leg following trauma extended from the site of trauma up the thigh. Reasoning that the amputations performed by these workers, which had been symmetrical, had not been sufficiently proximal to the site of trauma, Blalock carried out amputations in the midabdominal region and then compared the weights of the corresponding limbs. With severe trauma, the weight of the limb increased in an amount equal to 4 percent of the body weight. With less severe trauma the increase in weight of the limb ranged from 1.62 to 3.66 percent of the body weight. The average volume of blood among dogs has been determined to be approximately 9.7 percent of the body weight so that this loss of approximately half of the total volume of blood was thought to be sufficient cause, in itself, for the decline in blood pressure.

Parsons and Phemister,[28] also in 1930, reported similar experiments with similar results. The type of fluid lost was shown by Blalock to be chiefly plasma, although with more severe trauma, actual hemorrhage would occur and the type of fluid lost in these instances would be blood and plasma. Similarly in cases of intestinal trauma and in the case of burns the fluid was shown to be of approximately the same nature as that of plasma. This local loss of plasma protein was then advanced as the important factor in the production of shock. This

[2] Blalock, Alfred: Experimental shock; the cause of the low blood pressure produced by muscle injury. Arch. Surg., 20: 959–996 (June) 1930.

[3] Blalock, Alfred: Experimental shock. VI. The probable cause for the reduction in the blood pressure following mild trauma to an extremity. Arch. Surg., 22: 598–609 (April) 1931.

[4] Blalock, Alfred: Acute circulatory failure as exemplified by shock and haemorrhage. Surg., Gynec. & Obst., 58: 551–566 (March) 1934.

[23] Cannon, W. B., and Bayless, W. M.: IV. Note on muscle injury in relation to shack. Med. Res. Council, Special Report Series No. 26, pp. 19–23, 1919.

[26] Smith, M. I.: Studies on experimental shock with especial reference to its treatment. J. Pharmacol. & Exper. Therap. 32: 465–508 (April) 1928.

[27] O'Shaughnessy, Laurence, and Slome, David: Etiology of traumatic shock. Brit. J. Surg., 22: 589–618 (January) 1935.

[28] Parsons, Eloise, Phemister, D. B.: Hæmorrhage and "shock" in traumatized limbs. Surg., Gynec. & Obst., 51: 196–207 (August) 1930.

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conception stands in direct contrast with that regarding the general loss of fluid owing to the presence of toxemia.

The vexing problem involved in the use of the tourniquet experimentally has been investigated by many workers. The femoral arteries and veins were isolated and the remaining structures were occluded by pressure. When the vein was obstructed and trauma was applied, the blood pressure fell. With release of the obstruction, no great further decrease of blood pressure occurred and if both artery and vein were occluded no great fall of blood pressure occurred. These observations indicated that the loss of fluid locally was the important factor in the production of shock and that the cause was not the elaboration of some toxic substance, for this substance, if present, would have reached the general circulation through the unoccluded veins. Both Blalock and his coworkers and Parsons and Phemister ruled out the possibility that nervous impulses could be causative factors in the production of shock.

Morbid Anatomy

Recently Moon [5 6] has supported the hypothesis that toxemia is a factor in the production of shock, on the basis of pathologic studies. He has emphasized repeatedly the difference between shock and hemorrhage as shown by the results of examination after death. The features of shock were found to be concentration of the blood, congestion of the viscera, engorgement of capillaries with edema of tissues, petechial hemorrhage and effusion into serous cavities. These changes were contrasted with those associated with hemorrhage in which dilution of blood and pale, ischemic viscera were noted. O'Shaughnessy and Slome's [27] description of the pathologic picture following shock caused by histamine resembled the description of Moon, but the changes in the cases of traumatic shock included general pallor of the viscera, especially of the omentum and intestines, a pathologic picture resembling that associated with hemorrhage.

On these discrepancies, Blalock has thrown light. If the blood pressure of a dog is lowered by bleeding and then the blood pressure is maintained at a low level either by producing small hemorrhages or by administering small transfusions, according to the need, the conditions produced in the tissues will consist in concentration of the blood, congestion of the capillaries, hemorrhage, and necrosis. There may even be free blood in the intestinal canal. From these observations, Blalock felt that the differences between the pathologic picture of shock and of hemorrhage are dependent on the lapse of time following the injury. Should the hemorrhagic process terminate early,

[5] Moon, V. H.: The shock syndrome in medicine and surgery. Ann. Int. Med., 8: 1633-1638 (June) 1935.

[6] Moon, V. H.: Shock, its mechanism and pathology. Arch. Path., 24: 642-663 (November) 1937.

[27] O'Shaughnessy, Laurence, and Slome, David: Etiology of traumatic shock. Brit. J. Surg., 22: 589-618 (January) 1935.

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the tissues will be pale and ischemic and the blood will be diluted by the body fluids. When there has been long and continued hemorrhage, however, there seems to be a more progressive loss of fluid from the blood due to anoxemia and to increased permeability of the capillaries so that the blood becomes more concentrated.

Sequence of Physiologic Events

From the results of such studies as those mentioned in the preceding section, authorities on the subject of shock have postulated that a sequence of physiologic events occurs in the production of shock. Beginning with a reduction of the volume of blood due to loss of plasma and blood locally, the first result is diminished cardiac output. An attempt to compensate for this evidently calls into play reflexes, such as the carotid sinus reflex, which produces an increase in the rate of the heart beat and in vasoconstriction. The increase in the rate of the heart beat tends to maintain a normal output of blood per minute although the output of the heart per beat may be less than previously. Vasoconstriction through pressor reflexes and through stimulation of the sympathico-adrenal system tends to maintain normal blood pressure. Through the sympathico-adrenal system, the blood depots of the body such as the spleen, the subpapillary plexuses of the skin, and the veins, tend to maintain an effective circulating volume of blood through relaxation of the hepatic sphincter. A point may be reached, however, at which these compensatory mechanisms no longer function and in this situation the output of the heart may fail to maintain the systemic blood pressure. In order to correct this condition, an attempt to restore to normal the volume of blood obviously would be essential.

As pointed out by Cannon,[21] the occurrence of clinical phenomena such as the dusky appearance of the skin, the bluish fingernails, the high corpusular count and the clogging of capillaries in the intestinal villi are explained satisfactorily. Cannon further emphasized the fact that, although vasoconstriction of the cutaneous and splanchnic blood vessels occurs as a result of stimulation by adrenalin, dilatation of the blood vessels of the musculature also occurs. Under ordinary circumstances, the muscular movements will assist the fluid in the capillary spaces to return to the general circulation, but among patients suffering from shock an enormous reservoir of fluid might form in the tissues. This would account for much of the decrease in the volume of blood.

Clinical Experience

The clinical picture of shock is known too well to justify much discussion. The falling blood pressure, the cold clammy skin, the beads

[21] Cannon, W. B.: A consideration of possible toxic and nervous factors in the production of traumatic shock. Ann. Surg., 100: 704–713 (October), 1934.

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of perspiration standing out on the forehead, the apathy, the occasional vomiting and weak rapid pulse, the dusky skin and bluish fingernail beds, and the increased corpuscular count all are well recognized. The most widely recognized conditions after which shock may develop are burns and injuries, either through accident or in the course of an extensive surgical procedure. Shock complicated and aggravated by hemorrhage, in which there may not be a history of injury, is illustrated well by cases of ectopic pregnancy in which rupture has occurred. Hemorrhage complicated by shock is best exemplified by the cases of severe shock following acute inversion of the uterus superimposed on the existing hemorrhage. In this latter instance shock is presumably caused by trauma to the ovaries, thus superimposing a condition of primary shock on that of secondary shock. Attention may be drawn at this point to the type of case in which operative repair of a large ventral hernia is necessary following which fatal shock may develop late.

Therapy

Therapeutic measures in the treatment of secondary shock should be directed toward preventing the development of factors notable in the production of shock. Thus, pain, fear, and emotional disturbances should be eradicated as much as possible. The use of morphine preoperatively and the use of derivatives of barbital, notably nembutal, cannot be stressed too much. During the operation itself, the maintenance of the body at a proper temperature should receive detailed consideration. If the duration of the operation is brief this may be a negligible factor but when a lengthy operation is to be performed the simple use of hot water bottles under the sterile drapes, especially around the extremities of the patient, has proven very valuable. The use of a blanket wrapped around the legs should not be forgotten. Freeman [29-31] has stressed the importance of dehydration in the production of shock. As much as possible this may be corrected preoperatively by hospitalization for a few days during which time fluids may be administered intravenously. In cases of prolonged operations, it is a common practice to introduce a gold cannula or an ordinary intravenous needle into a vein so that a portal may be readily available for the introduction of fluids, particularly blood.

Much has been written about the lack of beneficial results from the administration of vasoconstricting drugs. Certainly ephedrine (.025

[29] Freeman, N. E.: Decrease in blood volume after prolonged hyperactivity of the sympathetic nervous system. Am. J. Physiol., 103: 185-202 (January) 1933.

[30] Freeman, N. E., Morison, R. S., and Sawyer, M. E. M.: The effect of dehydration on adrenal secretion and its relation to shock. Am. J. Physiol., 104: 628-635 (June) 1933.

[31] Freeman, N. E.: Haemorrhage in relation to shock: experimental effect of intravenous injections of saline, gum acacia, and blood on the rate of adrenal secretion resulting from haemorrhage. Ann. Surg., 101: 484-493 (January) 1935.

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gm.) intravenously or neosynephrin [32] should be at hand during an operation. The use of such drugs subsequent to operation may be condemned on the basis of adding to an already present deleterious process, namely, that of vasoconstriction. Even in this instance, these drugs have a certain value, although the one necessary fundamental in the treatment of secondary shock is the maintenance of the volume of blood. In actual practice this may be difficult due to low blood pressure, making it almost impossible to introduce intravenous fluids. In this instance the use of ephedrine may transitionally raise the blood pressure permitting the introduction of an intravenous needle. Raising the foot of the bed of the patient on shock blocks following operation may not be an experimentally sound procedure, but clinically it is often most efficacious.

In the presence of fully developed surgical shock, efforts should be directed toward restoring an effective volume of blood. It is essential that this be done without delay. Experimental evidence shows that low blood pressure if present for too long a time, leads to permanent damage and that, although the blood pressure subsequently may be raised by injection of fluid, frequently an ultimate fall of blood pressure and a fatal outcome ensue. Freeman's experiments with the effects of the sympathico-adrenal system led him to believe that the administration of solutions of acacia intravenously or the use of blood transfusions is adequate to maintain elevation of the blood pressure and to inhibit the secretion of adrenalin. MacFee and Baldridge,[33] however, stressed the superiority of giving large amounts of saline solution; a contention which, in view of the previous discussion of the low osmotic pressure consequent on loss of plasma, would scarcely seem to be borne out by facts. Hinton [34] mentioned the advantageous use of a compound solution containing 6 percent of acacia and 20 percent of *d*-glucose, if blood is not available. Our own clinical experience is that blood is preferable, but if not available a solution of acacia should be used. With the present day preparation of intravenous fluids by the larger manufacturing agencies on a commercial basis, it would seem feasible to have solutions of acacia on hand for use on a moment's notice.

In conclusion, it must be stressed that surgical shock, although not so often encountered in its profound manifestations in present day practice as formerly, needs and demands early adequate treatment.

[32] Johnson, C. A.: Neo-synephrin hydrochloride in the treatment of hypotension and shock from trauma or hemorrhage. Surg., Gynec. & Obst., **65**: 458-463 (October) 1937.

[33] MacFee, W. F., and Baldridge, R. R.: Physiological considerations related to the infusion treatment of shock. Ann. Surg., **100**: 266-278 (August) 1934.

[34] Hinton, J. W.: Shock, its prevention and treatment. Surg. Clin. N. Amer., **15**: 287-293 (April) 1935.

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SURGICAL HIGH-LIGHTS OF 1938 [1]

By Capt. Lucius W. Johnson, Medical Corps, United States Navy

A point of view may mark an epoch, but few of us are blessed with the finesse which is necessary to translate it into words. The following excerpt from a recent article by Ogilvie appears to express in plain language the ideal of the well-equipped surgeon of today.[2]

When I was a student, I heard a famous surgeon say, as he took up the knife to remove an appendix, "the bogey for this operation is 6 minutes." Today we look on such as remark, or rather the state of mind it betrays, as being just 120 years behind the times. * * * But today when innumerable anesthetic methods suitable to every occasion are available, the only possible ideal of surgery is that the operation should be done as well as possible. If, by adding 10 minutes to its time, it can be improved in the least detail, those 10 minutes must be taken. If by suturing an additional layer; if by substituting interrupted stitches for continuous, more perfect healing is more surely attained, those extra steps must certainly be adopted. Bogey should be tissues divided gently and cleanly, as far as possible along anatomical planes; hemorrhage forestalled rather than arrested; closure without tension or strangulation of living tissues in the grasp of sutures, yet with anatomical reconstruction of divided planes and obliteration of all dead space. After an operation so performed the patient should return to bed neither shocked nor exsanguinated, reacting to the ordeal no more than to that of a hard game of tennis.

That is an ideal for surgeons to shoot at during the coming year.

Graduate training in surgery will be facilitated by a definite plan that is ready to be put into effect by the American College of Surgeons, and it is regarded as one of the most important movements to stimulate better surgery. Many institutions are already adopting the plan, with its practical and educational features. It is desired that every approved hospital large enough to offer the diversification of practice and the facilities for graduate training should conform to the general scheme. Our naval hospitals which are approved for interne training will, no doubt, be able to conform to the common plan.

The criteria for consideration in organizing for graduate training in surgery are the following:

1. A well-organized medical staff, with department heads responsible for the organization and operation of the graduate-training program.
2. An adequate average patient census, of the types of patients suitable for teaching purposes.
3. Complete laboratory and x-ray facilities under the full-time supervision of competent specialists.
4. Adequate diagnostic and therapeutic facilities.
5. Departmental conferences in surgery and the surgical specialties at least weekly, in which those under training should be encouraged to take part.
6. Weekly clinico-pathological conferences for the demonstration and study of interesting cases of surgical and postmortem pathology.

[1] From the point of view of an ex-surgeon, who still tries frantically to keep up with the literature.
[2] Ogilvie, W. H.: Lancet, 235: 788, October 1, 1938.

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7. An out-patient department with systematic follow-up clinic, in which those under training may spend definite time.

8. A medical library containing a wide range of standard text-books, current medical journals and periodicals in sufficient number for supplementary reading.

9. Affiliation, if possible, with other educational institutions, to provide for collateral basic science studies.

10. Assigned personnel, responsible for active and personal supervision and direction of those under training.

11. Reports of actual work performed by those under training.

Nos. 5, 6, 7, and 9 will require the most attention in naval hospitals, but in all our hospitals that have been approved for training, it should be possible to provide facilities better than the average of civil hospitals.

WATER BALANCE and fluid loss in surgical patients continues to receive increasing attention. Only recently have we come to appreciate the importance of insensible water loss during and after operation. To reduce this loss, the use of ether is to be avoided whenever possible; the temperature of the operating room should not be allowed to go above 80° F.; the lightest possible drapes should be employed. Infusions of 5 percent glucose are recommended during long operations, continued on the ward until 2,000 cc have been given within the next 4 hours.[3] Standard stresses the point that replacement should be made slowly, and patients in dehydration, especially older persons and those with circulatory failure, should be rehydrated judiciously. He recommends the reestablishment of the urine flow by the use of a hypotonic solution, glucose in 0.4 percent saline.[4]

An attempt has been made to estimate the exact fluid requirements of surgical patients. The average insensible loss per day ranged from 1,154 to 1,830 gm, with an average, in 175 twenty-four hour estimations, of 1,457 gm. The insensible loss averaged 39.4 percent of the total output. It bore no constant relation to the output of urine, which is not a reliable criterion of the needs of the patient. The insensible loss varied with the size of the patient rather than with the type or extent of the surgical procedure.[5]

STERILIZING PRACTICES in hospitals throughout the country have been studied and a startling ignorance and carelessness in the use of sterilizers has been revealed. This is a matter which the average surgeon passes on to the nurse, who has no mechanical training, and often possesses only a hazy idea of what all the gadgets are for. Recurrence of infected operative incisions has frequently been blamed on suture material when it should have been attributed to incomplete sterilization of other materials. Efficiency of steam sterilization depends on two things—temperature of saturated water vapor in

[3] White, J. C., Sweet, W. H., and Hurwitt, E. S.: Ann. Surg., **107**: 438, 1938.
[4] Standard, S.: Surg. Gynec. & Obstet., **67**: 301, October 1938.
[5] Fuge, W. W., and Hogg, B. M.: Ann. Surg. **108**: 1, July 1938.

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contact with the least accessible spore in the depths of the unsterile material, and the duration of the exposure to the hot vapor. Fouling of the air ejector, dressings packed too tightly, failure to observe the sterility control device, are common factors which allow incomplete sterilization. A control has been devised which locks the sterilizer until the contents have been properly sterilized.[6] Manufacturers are emphasizing the fact that pressure readings may be fallacious if the air ejector is blocked, and that only temperature readings are reliable. The Bureau of Standards is said to require the thermometers supplied with sterilizers to be accurate within one degree and to be located at the coolest place near the steam outlet. The assumption that sterilizers are infallible and automatic endangers one of the most essential safeguards of surgery.

Electrolysis in metallic fixation of fractures is being emphasized as an important element influencing fracture healing.

Corrosion of metal through the action of electric currents produces substances which may injuriously affect bone and soft tissues as well as cause disintegration of the metal.

Vitallium, which is an alloy of cobalt, chromium, and molybdenum, appears to be electrically neutral and to remain entirely free of corrosion when buried in the tissues. It produces no measurable amount of electric current in the body, except at the moment of contact. Plates, screws, and nails made of this material are coming into widespread use and it appears that they do not cause overstimulation, demineralization, or necrosis of bone. This substance is too hard to be milled and each article has to be individually cast which makes them expensive. Now that electrolysis has been shown to be the cause of the failure of metallic fixation, it is probable that cheaper, but equally satisfactory materials will be produced.[7] Vitallium was used in dental prosthetic work for some years before its introduction into orthopedic surgery and it is practically unaffected by mouth fluids.

Cellulose, for casts, has been demonstrated to be a superior type of material in that it is light-weight, durable, waterproof, and will transmit x-rays without confusing shadows. A recent discovery has made available a cellulose compound, long used in industry, for this purpose.[8,9] Boric acid and a safe type of pyroxylin, dissolved in acetone, are the constituents. When the acetone has evaporated, the hard cast is no more flammable than wood. When applied to the skin no irritation has been observed, but it is usually applied over a layer of stockinet or sheet wadding. Hardening requires about 40 minutes.

[6] Walton, C. W.: Surg. Gynec. and Obstet., 67: 526, October 1938.
[7] Venable, C. S., and Stuck, W. G.: J. A. M. A., 111: 1349, October 8, 1938.
[8] Thorndike, A., and Garrey, W. E.: New Eng. Med. Journ., 218: 205, 1938.
[9] Joplin, R. J.: Journ. Bone and Joint Surg., 20: 439, April 1938.

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ANESTHESIA.—A review of anesthetic procedures used at the Mayo Clinic indicates that tumors of the breast are no longer removed under regional anesthesia. Formerly, when induction of general anesthesia became necessary after the biopsy, the patient realized that the condition had been found malignant, and she was not in proper mental attitude for smooth anesthesia by inhalation.[10] Now, general anesthesia is used from the beginning of the operation. Nitrous oxide, oxygen and ether, or cyclopropane are preferred for general inhalation anesthesia. For operations on the chest, such as resection of ribs, or extensive thoracoplasty, intravenous anesthesia with pentothal sodium has been satisfactory, but must be skilfully used because of the lowered vital capacity. Ether is undesirable for chest operations because of its irritating action. The intratracheal tube is a valuable adjunct.

Operations on the upper abdomen in debilitated patients may be done under a combination of abdominal block anesthesia with a 0.5 percent solution of procaine or of metycaine, with epinephrine, plus an anesthetic agent given by inhalation, such as nitrous oxide or cyclopropane. The upper abdominal block is carried out by infiltration of the skin and subcutaneous tissue along the costal margin and down the lateral border of the rectus, deep into the body of the muscle. Between 100 and 150 cc of the solution are used, and very little of the inhalation anesthetic is needed.

The dose of procaine or metycaine for spinal anesthesia is never more than one mg for each pound of body weight, and not over 200 mg in any case. Ten to 25 percent less of metycaine than of procaine is needed. The factors which influence the depth of anesthesia and the degree of relaxation are: (1) The dose, (2) site of injection, and (3) the volume of spinal fluid withdrawn, with which the dose of the medicament is mixed. For example, 120 mg of procaine mixed with 4 cc of spinal fluid in the syringe gives a concentration of 3 percent; 120 mg mixed with 3 cc of spinal fluid gives a concentration of 4 percent. Concentrations higher than 5 percent or lower than 3 percent are not desirable.

REGIONAL ILEITIS is an inclusive title under which a chronic, sclerosing disease of the lower ileum has been reported. It appears that there are a number of agents which may produce granulomatous lesions in this region, but the etiology of most of them is unknown. There is usually a chronic, nonspecific inflammation of the lower 12 inches of the ileum, which eventually results in stenosis and obstruction of the bowel, sometimes with internal or external fistula formation. It is interesting to observe that a very large percentage of the patients have undergone appendectomy, without relief of symptoms, as the first step in treatment. At operation, the bowel may be found to be heavy, wet, and soggy, if in the early stages; or firm, ropy, and fibrotic

[10] Tuohy, E. B.: Proc. Staff Meet. Mayo Clin., 13: 570, September 7, 1938.

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in a later stage. An erroneous diagnosis of tuberculosis of the bowel is usually made at the time of operation.

HEART SURGERY has progressed to the stage where heart valves can be resected and successfully replaced by venous grafts. Three Canadian writers describe the technique by which they have accomplished reconstruction of the valves of the heart in dogs.[11] Two of the animals are alive and well 6 months after operations.

Paroxysmal tachycardia has been successfully treated by Leriche and Fontaine, by surgical removal of the stellate ganglion. Attempts to secure the same result by alcohol injection of the ganglion appear to have been successful.[12] The treatment was given during an attack, which came on just as the local anesthetic was being introduced. Within a very short time the heart rate dropped from 216 beats per minute to a rate of 88. A Horner's syndrome soon developed in the right eye. During the ensuing 2 years, the patient has been entirely free from tachycardia.

A collective review of the literature on surgical treatment of hypertension states that we are now at a critical stage in its development.[13] There is a lack of agreement on the meaning of the terms "essential" and "malignant" in describing hypertension, and a common definition of the types is one of the necessary preliminaries to any serious investigation of the subject. So little is known of the nature of hypertension that it constitutes one of the most difficult problems in all medical endeavor.

From the Mayo Clinic come enthusiastic reports of the results of surgical treatment. At present they are doing a subdiaphragmatic, extraperitoneal, bilateral resection of the splanchnic nerves, and a removal of the upper two lumbar ganglia with the intervening chain. This procedure, they believe, completely denervates the splanchnic vessels, the adrenal glands, and the kidneys. The Mayo group accepts the neurogenic hypothesis of the cause of hypertension, believing the syndrome to be due to a hypersensitivity of the vasomotor mechanism in certain individuals. A considerable number of failures and undesirable sequelae still occur.

Many other writers decry all operative treatment until the nature of hypertension is known. There is little agreement on the criteria for selection of cases suitable for operation, and there is difference of opinion on what constitutes hypertension. However, there appears to be an increasing trend toward surgical treatment by extensive sympathectomy and ganglion resection.

TRAUMATIC FINGER AMPUTATION is best treated by immediate trimming of the stump, and covering the raw area by a pedicled flap

[11] Murray, G., Wilkinson, F. R., and MacKenzie, R.: Canad. Med. Assoc. Journ., **38**: 317, June 1938.
[12] Coleman, E. P., and Bennett, D. A.: Surg. Gynec., and Obstet., **67**: 349, September 1938.
[13] Martin, J.: Surg., Gyn. and Obstet., **67**: 419, November 1938.

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from the pectoral region, or from some convenient area on the limb itself, according to Webster.[14] He makes a strong plea for careful consideration of plastic principles in amputations. He finds that free skin grafts transplanted on open stumps speed the healing. Pedicle flaps from a distance are useful in the closure or the revision of unsatisfactory amputation stumps. By this means the necessity of excising valuable portions of extremities to obtain closure may be avoided. Lack of skin on the limb need not limit the length of the stump if carefully planned pedicle flaps are used.

INJECTION TREATMENT of many surgical conditions appears to increase in importance. Many new books have appeared during 1938, on the injection treatment of hernia, hydrocele, hemorrhoids, and varicose veins. What was once scorned and left to the itinerant quack has now become one of the livest of surgical topics. Many industrial corporations, insurance companies, and State industrial commissions now require the injection treatment of hernia instead of operation, in suitable cases. Sooner or later, the Medical Department of the Navy must face this issue. It is to be hoped that our medical officers will be ready, with a background of experience rather than of prejudice, to give an answer either for or against the injection treatment of hernia when that time comes. With about 1,500 operations yearly, and an average of about 40 sick days for each case, this is a matter of vital interest to the Navy. Watson has found that 90 percent of hernias are suitable for this method of treatment, and the patient does not lose a single day from his work.[15] Recurrences average about the same after operation or injection, but the injection can be repeated in case of failure, with no loss of time. Injection treatment of varicose veins and hemorrhoids is already so widespread in the Navy that there can be no question of its efficacy.

TRANSFUSION of blood has been much in the public eye. The dramatic idea of conserving the blood of cadavers for injection into the veins of the living has fired the imagination of public and profession alike. Blood banks are being established in large hospitals and in many communities. Placental blood is being salvaged and reused. The Red Cross is establishing a service of volunteer donors for indigent patients in many cities. One can foresee that, in the next war, those who stay at home will be moved to do their bit by donating their blood to a bank for wounded soldiers. The blood may be transported, perhaps in glass-lined tanks, to the hospitals near the front, where it will be available for emergency use in the casualties of war.

In the Boston City Hospital is a placental-blood bank which gives gratifying results.[16] The yield has averaged 105 cc for each placenta. Careful controls are necessary to avoid contamination. Placental

[14] Webster, J. P.: Surg. Clin. N. A., 18: 441, April 1938.
[15] Watson, L. F.: Hernia, The Mosby Co., St. Louis, 1938.
[16] Grodberg, B. C., and Carey, E. L.: New Eng. Journ. Med., 219: 471, September 29, 1938.

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blood has a definite advantage over whole blood from the general circulation, in that it contains no allergins, so reactions are few and mild. The blood has been used after being preserved as long as 30 days.

Reactions following transfusion have been carefully studied by Sibley and Lundy to determine whether the benefits to be derived from it were lessened when a reaction occurred. They found that, in the average case in which 500 cc of citrated blood were given by transfusion, there was an increase of about 1.5 gm per 100 cc (about 9 percent) in the value for hemoglobin of the recipient's blood. There was definitely less increase in the hemoglobin when a reaction to transfusion occurred, averaging but 50 percent as much increase when a reaction occurred.[17]

Wartime use of preserved blood will be widely employed in the German Army.[18] Already, the Italian, Japanese, Argentine, and other countries are preparing for its use. The present Spanish War is being used as a proving ground for methods of blood preservation, transportation, and infusion. A similar story comes from Belgium, where this very live subject is being carefully studied.[19] Present methods permit the saving and use of blood for about 15 days, without any serious loss of its therapeutic qualities. Both the citrate and the whole-blood methods, with a temperature below 40° F. are in use. In Barcelona is maintained a blood bank of citrated blood, with a list of 4,500 donors, each of whom agrees to give 400 cc of blood per month to the bank. This is transported to the front in wagons fitted with electric refrigerators. At Salamanca several centers for blood donors are in operation, with more than 9,000 donors, aged from 16 to 50, many of whom have given their blood a dozen times or more. The blood transfusion organization is a part of the laboratory service of the army, with a considerable number of technicians who are prepared to give the transfusions without loss of time

Elaborate experiments have led to the conclusion that plasma is superior to whole blood, saline, or acacia as an intravenous injection in cases of shock, since rapid loss of plasma is an important factor in producing shock. Mahoney uses a dried plasma, prepared by rapid dehydration in the frozen state under a high vacuum.[20] When rediluted, it retains its original biologic and chemical characteristics.

Ascitic fluid, given intravenously in cases of shock, is proving to be superior to transfusion of whole blood or the usual fluids. Means of detoxicating and preserving it have been worked out. The ascitic patient may soon be able to aid others to regain the health he may never know himself.

[17] Sibley, W. L., and Lundy, J. S.: Surg., Gynec., and Obstet., 67: 293, September 1938.
[18] Franz, C.: Deutsche Militärarzt, 3: 31, Okt. 1938.
[19] Archiv. Belges du Service Santé de L'Armée.: 91: 276, October 1938.
[20] Mahoney, E. B.: Ann. Surg. 108: 178, August 1938.

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PERINEPHRITIC ABSCESS.—Few diagnostic problems offer more difficulty than perinephritis which goes on to abscess formation, especially the type in which the infection is carried by the blood or lymph stream, and the urine is free of pus or organisms. A method is now advocated, whereby valuable aid can be obtained by the roentgenogram.[21] The characteristic features of the film are, obliteration of the psoas muscle shadow, scoliosis of the lumbar spine, and obliteration, or else fixation, of the kidney shadow.

SCIATICA.—Mixter, Ayer, Goldthwaite, and others have pointed out the importance of protrusion of an intervertebral disk into the spinal canal as a cause of sciatica and low back pain. General recognition of this discovery has come slowly, but, during the past year, much attention has been paid to the subject, and many more patients are being successfully operated than in previous years.

All patients with acute sciatica should have a careful, general physical examination, roentgenograms of the lumbosacral spine, a complete blood and urine examination, also orthopedic and neurologic studies, and a search for foci of infection. If conservative treatment does not effect a cure, and the cause has not been discovered, a lumbar puncture through the first sacral interspace should be done. The first 3 or 4 cc of spinal fluid removed should be kept separate for determination of the total protein, while 5 to 6 cc more should be taken for the cell count, colloidal gold and Wassermann test. After 8 to 10 cc have been removed, the manometric reading should be repeated. If there is a distinctly elevated total protein, up to 45 mg, spinograms should be made with air or lipiodol, preferably the former, because it rapidly disappears. In a recent summary of the subject Poppen recommends the injection of 20 cc of air into the canal, removing a similar amount of fluid.[22] The patient should be in the Trendelenburg position, on the tilting X-ray table. When air is injected, the patient should be on his back. Anteroposterior stereoscopic roentgenograms of the lumbosacral spine, as well as several exposures at different angles in the lateral position are taken. Most of the defects can be demonstrated by injection of air, but if there is doubt, lipiodol should be injected, as it can be removed at operation. If a herniated disk is established, the treatment is operative removal. Prompt and permanent recovery is the rule in cases where the diagnosis has been correct, and operative removal has been complete.

TUBERCULOSIS.—Surgical treatment of tuberculosis has evolved so rapidly in the last decade that a summary of its position at the moment seems worth while. In America, there was little interest in this field before the work of Alexander, which was published in 1925. Now there is great activity, and the matter is briefed by Ferrara in a

[21] Goldstein, A. E., and Ostro, M.: Amer. Journ. Roent., 40: 371, September 1938.
[22] Poppen, J. L.: Surg. Clin. N. A., 18: 879, June 1938.

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very intelligent manner in a recent article which offers an excellent summary of the use of surgery in tuberculosis for those who are interested in this field.[23] The most important surgical procedures, from the standpoint of proven results are the following:

(1) *Artificial intrapleural pneumothorax* has a twofold function. First, in a lung without excavation it acts to permit the lung to have a maximum of rest, comparable to splinting a fracture. Second, in a lung where cavitation is present, the collapse of the lung not only brings about rest, but also serves to promote closure of the cavity. The indications are many and varied, including the following: Prolonged hemoptysis, which is the most urgent indication; minimal lesions which do not respond satisfactorily to bed rest, after a trial of 4 to 6 weeks; moderately advanced cases, where it is used most extensively; and suitable far advanced cases. If there is very extensive disease in both lungs, it should not be used, because the vital capacity is greatly reduced. In acute tuberculous pneumonia it may be a valuable aid if judiciously employed.

Bilateral pneumothorax, either simultaneous or progressive, has a definite place in the treatment of:

1. Limited progressive bilateral disease without cavitation.
2. Bilateral cavitation, preferably the moth-eaten type.
3. Reactivation of trouble in the contralateral lung.
4. Uncontrollable hemoptysis in the opposite lung.
5. Occasionally pleurisy with effusion in the opposite pleura.
6. Acute tuberculous pneumonia, when not too acute.

The contra-indications for bilateral pneumothorax are:

1. Extensive bilateral lesions with or without cavitation.
3. Large, thickened-wall cavities that resist compression.
2. Extensive fibrosis in both lungs.
4. Extensive pleuritic adhesions.
5. Patients over forty years of age.
6. Extensive extrapulmonary complications.
7. Threatening cardiac decompensation.
8. Extremely low vitality and marked toxemia.

How often can artificial pneumothorax be successfully induced? Twenty to twenty-five percent of attempts are failures, because of adhesive pleurisy. Since it is so often efficacious, why not employ it at once in all cases? Because the simpler methods of rest and feeding are sufficient in a considerable number of cases, and because of the danger of its most dreaded complication—empyema. Also because, if successful, it must be maintained for a minimum of 2 years.

(2) *Closed intrapleural pneumolysis* consists of severing adhesions which hold the lung to the parietal pleura and which prevent collapse by pneumothorax. Pleuritic adhesions are the cause of 40 percent

[23] Ferrara, M. A.: Marquette Med. Review, 3: 23, October 1938.

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of the failures in pneumothorax, and 70 percent of these can be converted into successes by pneumolysis, so it is a most useful secondary procedure.

(3) *Phrenic nerve paralysis* may be made permanent, by cutting or removing the nerve, or temporary, by crushing it. The temporary method is now generally favored, so that the hemi-diaphragm can recover its function when the nerve recovers. Scaleniotomy of the three scalene muscles is sometimes employed as an adjuvant, especially for small apical cavities. Bilateral phrenic paralysis is seldom indicated.

(4) *Multiple intercostal neurectomy*, cutting the intercostal nerves, from the second to the ninth, inclusive, has been used to reduce the respiratory mobility of the thoracic wall. It is sometimes employed as a preliminary to thoracoplasty in patients who are not able to stand the whole operation at once. It is usually considered that it offers relatively little benefit for such an extensive operation. It should not be tried until pneumothorax and phrenic paralysis have failed, and thoracoplasty is impending.

(5) *Oleothorax*, the introduction of oil into the pleural space, is seldom used because of its few indications and its dangers. Its principal indication is in a case in which artificial pneumothorax has been successful for a time in controlling a lesion, but has later been thwarted by an obliterative pleuritis. Another use is to produce asepsis in a tuberculous empyema. Perforation of the lung and flooding with the oil may cause death, and when the oil escapes into the thoracic wall, painful paraffinomas may result.

(6) *Thoracoplasty* has the following indications:

1. A cavity which will not or cannot close, after other operative means have been employed.
2. An obliterative pleuritis which renders a formerly effective pneumothorax ineffective.
3. The development of a bronchopleural fistula.
4. The development in a patient under pneumothorax treatment of an empyema, usually the mixed tuberculous type, which makes the continuance of pneumothorax inadvisable and hazardous.

It is used most frequently for the moderately and far advanced lesions with cavitation, in which simpler procedures are not considered advisable, or have failed. It is a major surgical operation, which is not to be taken lightly. Frequently it offers the only hope for recovery, even though only a slim one, and the mortality is high. Some surgeons operate, with occasional success, on even the poor risks.

VITAMINS.—Americans, as a people, are accused of having the vitamin jitters, rushing madly off to buy the latest lip rouge, fingernail polish or cereal that is advertised over the radio to contain some fabulous vitamin. The validity of this accusation is supported by the enormous number of articles in the lay and medical magazines on

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vitamins. In the surgical field, vitamin deficiency is pointed out as a factor in peptic ulcer, cholecystitis, ulcerative colitis, various forms of gastro-enteritis, sprue, carcinoma, and a long list of other disorders. Certainly, the profession is vitamin conscious, and the people gladly modify their diet to conform with the latest word on the subject. At the moment, things are too much confused in the vitamin field for us to know just what is valuable and what is trash, but 1938 has witnessed tremendous activity, which shows no signs of abating.

The fat-soluble vitamin K is reported to aid in raising the prothrombin level in the circulating blood of jaundiced patients and, in some instances, to have a definite inhibitory effect on bleeding. Erosion of the gizzard in fowls may be produced by feeding a diet which is deficient in certain elements. The ulcers are accompanied by hyperacidity, and the acid response to injection of histamine is comparable to that found in man. Attempts to make practical application of this knowledge, to aid in the prevention and treatment of disease, are likely to be successful to a considerable extent.

Cod-liver oil has been tried as a local application in ulcers of the feet in diabetics with encouraging results. In 20 out of 21 cases treated, complete healing followed. Its healing action in wounds, burns, crushing injuries, superficial sores and carbuncles has previously been observed.[24]

A SPECIAL SHOCK ROOM in the new Albert Dock Hospital, London, provides emergency treatment for the severely injured who are in a state of shock.[25] Special stretchers are provided which can be lowered into a ship's hold. The ambulance interior can be heated, and it brings them directly into the shock room. The stretcher is taken from the ambulance onto a table, above which are radiant-heat lamps which can be immediately lowered over the patient. Ranged about the room are six dressing carts, each with towels of a different color, and each equipped with all necessaries for a special type of emergency, as follows:

1. For control of bleeding, with pressure forceps and other instruments, iodine, local anesthetic, tourniquets and bandages. 2. Blood-grouping apparatus, with needles, pipettes, slides and microscope. 3. Apparatus for saline and blood transfusion, Vacoliters, funnels, needles, and everything necessary for intravenous work. 4. Apparatus for collecting blood from a donor, sodium citrate, tourniquets, syringes, dressings, etc. 5. A drug table containing stimulants, narcotics, anesthetics, etc. 6. A cart for removing soiled dressings, shaving and cleaning wounds, removing oil, grease and other contaminants. There is a separate stand for oxygen and other inhalants.

[24] Brandaleone, H.: Ann. Surg., 108: 141, July 1938.
[25] Lancet, 235: 1017, October 29, 1938.

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RECENT ADVANCES IN ENDOCRINOLOGY

A RÉSUMÉ

By Lt. OMAR J. BROWN, Medical Corps, United States Navy

In 1937 there was published in the Bulletin a review of the general field of endocrinology which this article is intended to supplement.[1] Since that time there has been considerable work in this field. The present paper is offered as a brief summary of those developments which at this time appear to be the most significant. No attempt has been made to present an exhaustive review of the entire subject.

As Dr. Pottenger states, "Development of endocrinology has followed much the same course as the development of other phases of medicine. First the disintegrating method of studying individual glands and their products had to be pursued; but this must now give way to a process of integration, of fitting our knowledge into the whole picture of physiology." [2]

Due to the intimate relationship of the endocrine system, it is obvious that dysfunction in any one member, be it over or under activity, would naturally alter the harmonious relationship normally existing between the associated members. Therapeutic measures should therefore be aimed at the gland primarily at fault with the purpose of restoring the normal hormonal balance.

With manufacturers producing more highly purified and concentrated products from the natural sources, as well as the synthesis of several, the physiological responses to these agents can be determined with greater accuracy. That this subject is still far from simple is amply illustrated by the statement of Dr. Hoskins during a recent address before the Third International Goitre Conference in Washington, D. C. Remembering that hormonal dysfunction can be manifest only as a hypo- or hyper-function of the secreting gland and that variations in degree from complete absence to excessive overproduction can exist, he stated that there is the possibility of approximately 14,000,000 combinations of the 15 known and proved hormones circulating in the human blood stream. Naturally this allows for a multiplicity of clinical syndromes, but with it all the basic concepts as previously outlined remain unaltered.

Essentially, the more recent work has been along the lines of obtaining hormonal products of greater purity, the determination of the formula and synthesis of hormones, the development and application of new uses for the hormones which have been isolated, and the study of clinical cases in their interhormonal relationship.

[1] Dickens, P. F., and Brown, O. J.: Present Day Concepts of Endocrinology. U. S. Nav. Med. Bull., **35**: 8-33, Jan. 1937. U. S. Nav. Med. Bull., **35**: 176-195, Apr. 1937. U. S. Nav. Med. Bull., **35**: 387-417, October 1937.

[2] Pottenger, F. M.: Neural and Endocrine Factors in Bodily Defense. Endocrinology **21**: 449-454, July 1937.

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The Anterior Pituitary Gland

The continuing experimental biology directed towards the securing of overfunction or underfunction of the anterior pituitary still leaves us with the concept of the anterior pituitary gland as the master gland of the body. However, the factor activating this gland, as with many other vital activites of the body, is still unsolved. As yet there is no conclusive evidence that more than six hormones come from this gland, in spite of the many postulated activities accorded it.

Of the six definitely proved hormones from the anterior pituitary only two, the gonadotrophic and somatotropic (growth) hormones have been extensively used clinically. The use of the gonadotropic hormone from pregnancy urine has been used for numerous and sundry conditions, frequently empirically and without an understanding of its effects, but today its value in cryptorchidism, functional uterine bleeding, certain cases of acne vulgaris, hypogonadism, and delayed puberty seems well established.

The treatment of acne with hormonal products should be approached with caution. In the treatment of acne, Rosenthal reported that although better than 80 percent of his patients showed a subnormal amount of the estrogenic substance in their urine yet treatment of these patients with the gonadotropic hormone produced an improvement in only 60 percent.[3] McCarthy and Hunter have noticed that patients with indurated acne and acne cystica did not respond at all to this form of treatment, whereas in those cases exhibiting the papulopustular form the response was good.[4] The occurrence of this disorder at the time of puberty, when the body is under a marked hormonal stress, is highly indicative of its endocrine nature in many cases[5] as is also its development in cases under treatment with testosterone as reported by Vest and Howard.[6] It seems that by a careful selection of the type of case, based upon the skin response and an estimation of the quantity of the estrogenic hormone excreted, it might be possible to determine those cases in which hormonal therapy would be beneficial.

In cases of infantilism, dwarfism, and certain types of obesity this hormone appears to bring about favorable clinical results in some cases, especially when combined with thyroid therapy.[7]

The successful treatment of masculine sterility by the administration of the anterior pituitary-like gonadotropic hormone alone, or in

[3] Rosenthal, T.: Therapy of acne vulgaris with hormone preparations. New York State J. Med., 37: 244-248, February 1, 1937.

[4] McCarthy, L. and Hunter, O. B.: Failure of therapy with glandular preparations in acne vulgaris. Arch. Derm. & Syph. 35: 211-225, February 1937.

[5] Lawrence, C. H.: Anterior pituitary-like hormone; clinical study of its effect in acne vulgaris. J. A. M. A. 106: 983-987, March 21, 1936.

[6] Vest, S. A., and Howard, J. E.: Clinical experiments with the use of male sex hormones. I. Use of Testosterone propionate in hypogonadism. J. Urol. 40: 154-183, July 1938.

[7] Jacobsen, A., and Cramer, A. J. Jr.: Clinical results of anterior pituitary therapy in children. J. A. M. A. 109: 101-108, July 10, 1937.

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conjunction with thyroid, where the fault is aspermia or a decrease in the number and motility of the spermatozoa, has been reported on several occasions.[8] [9] [10] [11] By careful spermatozoa counts on normal adults, after establishing the normal cyclic variation, Rubinstein has shown that injections of 1,000 rat units of the anterior pituitary-like hormone, in divided doses three times a week, causes a very definite increase in the sperm count, but this lasts only so long as the injections are continued.[12] Huberman and his associates, although unable to produce fertility in sterile males, likewise noted an increased spermatogenesis with improved sperm morphology following doses of 50 R. U. weekly of the anterior pituitary-like extract from castrate or menopausal urine.[13]

The Pregnancy Tests

Many attempts have been made to devise a simple, rapid, inexpensive, and accurate test for pregnancy, but none so far can compare in accuracy with the biological Aschheim-Zondek test or the Friedman modification of it, each of which is dependent upon the presence of the anterior pituitary-like hormone in the urine. In spite of the theoretical possibilities of false positive readings, the Friedman modification has many advantages over the test as developed by Aschheim-Zondek, and if properly performed throughout gives just as accurate results. McHenry and Best report that in 2,359 tests the percentage of error was only 1.9 percent with the error more frequently false negative rather than false positive.[14] This percentage of error compares favorably with that of the original Aschheim-Zondek. During the past 2 years we have been doing both the Friedman and Aschheim-Zondek tests at the Naval Medical School and find that they parallel each other and that our results have been between 98–99 percent accurate as determined clinically, with false negatives the more frequent error. Osgood states "all other tests for the diagnosis of pregnancy have been superceded by the Friedman modification of the Aschheim-Zondek test." [15] It is true that the Friedman test, especially in the case of laboratories removed from the proximity of breeding

[8] Brosius, W. L., and Schaefer, R. L.: Spermatogenesis following therapy with gonad stimulating extract from urine of pregnancy. J. A. M. A. **101**: 1227, October 14, 1933.

[9] Charny, C. W.: Clinical study of male sterility with particular reference to endocrine dysfunction and therapy. J. Urol. **32**: 217–230, August 1934.

[10] Lloyd, V. E.: Gonadotropic hormones in treatment of sterility in man. Lancet, **230**: 474–475, February 29, 1936.

[11] Valerio, A.: Spermatogenesis; effect of injections of urinary hormones from pregnant women and of suprarenal cortical extracts. Urol. & Cutan. Rev. **40**: 81–82 February 1936.

[12] Rubinstein, H. S.: The effect of anterior pituitary-like hormones on spermatogenesis in the human. Endocrinology, **23**: 75–78, July 1938.

[13] Huberman, J., Israeloff, H., and Hymowitz, B.: Effects on spermatogenesis of a follicle stimulating extract obtained from menopausal or castrate urines. Endocrinology, **21**: 67–71, January 1937.

[14] McHenry, E. W., and Best, C. H.: Biological test for pregnancy. Canad. M. A. J., **37**: 151–152, August 1937.

[15] Osgood, E. E.: A textbook of laboratory diagnosis, second edition. P. Blakiston's Son & Co., Philadelphia, Pa. 1935.

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centers, has certain advantages; but it also has certain disadvantages. Its advantages are:

(1) The availability of animals (rabbits).
(2) If kept virginal and given adequate rest the animal can be reused, thus reducing cost.
(3) Except for filtration and warming, the urine requires no treatment.
(4) Rabbits being highly resistant to infection, there are fewer animal deaths.
(5) Results are available sooner; in an emergency the result can be read in 24 hours.

Its disadvantages are:

(1) Prior to using, the animal must be kept under observation for one full gestational period.
(2) The food cost of animal maintenance is greater.
(3) The test is not applicable for accurate quantitative work.
(4) Theoretically inaccurate results might occur as result of handling or owing to proximity of male rabbits.

In this test the errors, which are most likely to be to the side of a false negative rather than a false positive, may result from testing with—

(1) A too dilute specimen of urine.
(2) A urine too alkaline; the anterior pituitary-like hormone is most potent in an acid medium.
(3) Urine from a case too early in pregnancy.
(4) Decomposed urine due to improper preservation or poor refrigeration.

The Aschheim-Zondek test also has certain definite advantages as well as disadvantages. Its advantages are:

(1) It is the only reliable test at this time for the quantitative determination of prolan.
(2) There are no false positive results from handling.
(3) The test is positive with a smaller unitage of prolan.
(4) The food costs of maintenance are small.

Its disadvantages are:

(1) The short period of animal usefulness.
(2) The difficulty in determining the sex of young mice.
(3) The small laboratory not raising its own animals is dependent upon the reliability of the breeder.
(4) Interpretation is somewnat more exacting in that the dissecting microscope is required in the reading.
(5) False positive results are obtained if the animal matures and spontaneously ovulates. The chances for this error are minimized when the full number of mice are used—4 or 5 for each test.
(6) Urine must be carefully extracted to avoid toxic reaction and death.

Of the other tests devised for the determination of pregnancy, all, with the exception of the histidine test, the Gruskin test, and the antuitrin-*s* skin test are dependent upon the presence of the anterior pituitary-like or estrogenic hormone in the urine. They are so inaccurate that clinically they are of no value. Probably the best known

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of these tests is that introduced by Gilfillen and Gregg in 1936 using antuitrin-*s* as an antigen.[16] In this the intradermal injection of antuitrin-*s* is supposed to produce a local reaction in non-pregnant women and no reaction in those pregnant. The general opinion of numerous investigators is that the test is too unreliable for clinical use.[17] [18] [19] [20] [21] [22]

The Gruskin test is similar to the antuitrin-*s* test except that the antigen used is obtained by extraction from the placenta, while the histidine test is based on the presence and determination of this amino-acid in pregnancy urine. Both are unreliable.

Some of the other tests occasionally referred to in the literature must be mentioned only to condemn them on the basis of present experience, viz: The Visscher-Bowman test; the Bronuha test and the Zaharesco modification of it; the Mazer-Hoffman test; the Kelly test; all the fish tests, the female bitterling, the male bitterling, and the stechling tests; and lastly the frog tests, the South African frog test, and the frog color reaction.

There are numerous conditions, other than pregnancy, in which an accurate, more simple, and less expensive test is highly desirable. We realize the value of prolan determinations in the differential diagnosis and treatment of hydatidiform mole, chorio-epithelioma, teratoma of the testes, in the differential diagnosis of abdominal tumors and pregnancy, of acute abdominal crises involving the possibility of ectopic pregnancy, in the diagnosis of some pituitary tumors, as an index of the complete removal of the products of conception, and occasionally in medicolegal cases.

Growth Hormone

The growth (somatotropic) hormone of the anterior lobe of the pituitary, working in a harmonious equilibrium with the other hormones of the body, primarily those of the thyroid and gonads, controls postnatal, skeletal, and somatic growth. Obviously, disturbances in the elaboration of any of these hormones prior to the completion of skeletal development will result in abnormal growth. Evans and Long in 1921 demonstrated the presence of this growth

[16] Gilfillen, G. C., and Gregg, W. K.: New, rapid, economical test for pregnancy and certain gynecologic conditions. Am. J. Obst. & Gynec., **32**: 498-501, September 1936.

[17] Gill, A. M., and Howkins, J.: Antuitrin-*s* intradermal pregnancy test. Brit. M. J., **2**: 1069, November 27, 1937.

[18] Frank, C. W., and Wahrsinger, P. B.: Skin tests for pregnancy. Am. J. Obst. & Gynec., **35**: 303-304, February 1938.

[19] Gersh, I.: Antuitrin-*s* cutaneous test for diagnosis of pregnancy. Am. J. Obst. & Gynec., **35**: 301-302, February 1938.

[20] Lass, P. M., Suderle, E. S., and Kurzrok, R.: Skin tests and pregnancy. Endocrinology, **23**: 71-74, July 1938.

[21] Schneider, B., and Cohen, A. E.: Nonspecificity of gonadotropic factor of pregnancy urine intradermally as test for pregnancy. J. A. M. A., **109**: 115-117, July 10, 1937.

[22] Graffagnino, P., and von Haam, E.: Evaluation of skin tests for pregnancy. South. M. J., **31**: 169-173. February 1938.

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controlling factor in the pituitary, but although obviously suggestive as a method of treating those cases of stunted growth due to hypofunction of the pituitary, it was not applied clinically for nearly 10 years.[23] In 1932 Engelbach reported the successful production of growth in a pituitary dwarf and since that time numerous other reports on its use in this condition have appeared.[24] In 1935 Turner detailed his treatment in nine cases, in five of which the growth increment exceeded the average.[25] The following year Schaefer reported favorable results in 11 cases and Shelton reported five cases in which growth under treatment was greater than that anticipated on the basis of previous growth.[26] [27] Taylor has recently added eight more cases in which seven showed an acceleration of retarded growth as the result of treatment.[28] Higgins, however, in two cases, and Struck and Szurek in one case were unable to produce growth using pituitary medication.[29] [30]

Why it is that growth fails entirely in some cases is not known, and careful examination of the favorable reports shows that, while in certain cases growth may be stimulated beyond that previously attained by the patient, and even in cases may exceed that of the theoretical normal for the age of the patient, yet clinically the effects are not as striking as had been hoped for. Speaking from his clinical experience Shelton states, "We believe that while these preparations do not warrant enthusiasm regarding their growth-promoting properties, they are better than none. A much more potent extract is to be desired if it is to find practical use in clinical medicine." [27] Dods also feels that the growth hormone now available is of insufficient potency "to rehabilitate a classical dwarf * * * but if adenohypophyseal dwarfism is recognized at 2 years of age or earlier, it seems probable that excellent results may be obtained with injections of * * * growth factor preparations, as nearly 50 percent of the total statural growth of the human is reached by the end of the third year." [31] Evans and Novak have also commented on this failure of the growth hormone to bring about better clinical results and concluded that the low yield of the hormone from the glands of cattle,

[23] Evans, H. M., and Long, J. A.: The effect of the anterior lobe of the hypophysis administered intraperitoneally on growth, maturity, and the estrous cycles of the rat. Anat. Rec., 21: 62-63, 1921.

[24] Engelbach, W.: Growth hormone; report of case of juvenile hypopituitarism treated with Evans' growth hormone. Endocrinology. 16: 1-9, January-February 1932.

[25] Turner, H. H: Anterior-pituitary dwarfism; further report of cases treated with growth hormone. South. M. J. 28: 309-316, April 1935.

[26] Schaefer, R. L.: Endocrine dwarfism. Endocrinology. 20: 64-71, January 1936.

[27] Shelton, E. K.: Pituitary growth factor; some clinical considerations. California and West. Med. 45: 20-25, July 1936.

[28] Taylor, N. M: Pituitary dwarfism: treatment with growth hormone. Endocrinology. 22: 707-715, June 1938.

[29] Higgins, H. L.: Two cases of dwarfism. New Eng. J. Med. 214: 148-150, January 23, 1936.

[30] Struck, H. C., and Szurek, S. A.: Study of metabolism of dwarf under treatment with growth hormone. Endocrinology. 21: 387-393, May 1937.

[31] Dods, L.: Some aspects of pediatric endocrinology. M. J. Australia, 2: 255-260 August 14, 1937.

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the instability of the product and the lack of a source of pure or more concentrated material are the chief reasons.[32 33] Recently Evans and his associates have reported a method by which a purified growth hormone extract of 5 times the potency of that now in use may be obtained.[34] This product is yet to be clinically tested and reported.

Treatment of the pituitary dwarf by hormones is essentially substitutional. Theoretically the growth hormone is all that is indicated, but practically it has been found that the employment of thyroid extract concurrently is frequently beneficial. The treatment as advocated by most investigators is injection of 2–3 cc of the growth hormone every other day combined with thyroid extract to the point of individual tolerance, starting with 1 grain daily and increasing the dosage until a tolerance dose has been reached as determined by close observation of the pulse, weight, basal metabolic rate, and temperature.

When the therapeutic use of the growth hormone for any cause is anticipated, it is obvious that prior to the institution of treatment, x-ray studies of the epiphyses of the long bones of the extremities should be made in order to determine whether or not the epiphyses are open and if further growth is possible. Also it is most desirable to attempt a determination of the age of the ossification centers in comparison with the calendar age of the patient. If the x-ray picture equals or exceeds the calender age little hope from any form of treatment may be expected. On the other hand, however, when radiologically the age of the ossification centers lags behind the chronological age much better clinical results are usually obtained.

The Ovarian Hormones

Activation of the ovary to produce its own hormones is dependent upon the action of the two gonadotropic hormones of the pituitary. One of these pituitary hormones governs the development of the parenchymatous ovarian tissue and induces maturation of the graafian follicle. This is the follicle stimulating hormone (F. S. H.) or prolan-*a*. The other governs the development of the interstitial derivatives of the ovary and induces the formation of the corpus luteum following rupture of the matured follicle and is therefore known as the luteinizing hormone, (L. H.) or prolan-*b*. Thus, through the harmonious interaction of the hormones of the pituitary and the ovary we have the normal occurring cyclic waves of follicular maturation and luteinization during the reproductive period of a woman's life. Disruption of this finely adjusted equilibrium from any cause results in the multiplicity of menstrual disorders common in any gynecological practice.

[33] Evans, H. M.: Glandular Physiology and therapy. pp. 53. Amer. Med. Asso. Chicago. 1935.

[33] Novak, E.: Glandular physiology and therapy. pp. 122, Amer. Med. Asso. Chicago. 1935.

[34] Evans, H. M., Uyei, N., Bartz, Q. R., and Simpson, M. E.: Purification of anterior pituitary growth hormone by fractionation with ammonium sulphate. Endocrinology. 22: 483–492, April 1938.

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Likewise it is responsible for the symptomatology of the menopause. In conjunction with the thyroid, and possibly the adrenal gland, a harmonious ovarian-pituitary equilibrium is also responsible for normal maturing of the child into the adult.

In order to clarify the confusion in endocrinologic nomenclature that has developed during the past few years relative to the ovarian follicular hormone, the Advisory Committee on the Nomenclature of Endocrine Principles of the Council of Pharmacy and Chemistry, American Medical Association has adopted a system of nomenclature in common use by English investigators, based on the root *estr*—.[35] Under this system the adjective estrogenic is used "to describe those compounds or extracts which in addition to their other physiologic properties produce estrus," while the noun ESTROGEN is a collective term applying to all substances having these properties. However, since the Council previously had approved THEELIN as a common name (based on the Greek root *theely*, which in combination always indicates femaleness) it was decided to retain the names "THEELIN, THEELOL, and DIHYDROTHEELIN as synonyms for the compounds known in the aforementioned system as estrone, estriol, and estradiol, respectively." Since this nomenclature has been adopted it is to be hoped, for the sake of uniformity, that names for the sex hormone from the follicular cells of the ovary previously appearing in the literature, viz., ovarian follicular hormone, oestrin, estrogen, menformon, theelin, progynon, and thelykinine will be discarded.

Similarly the committee in conjunction with the European investigators has adopted the name PROGESTERONE as indicative of the chemical structure of the chemically pure substance having the property of acting on the rabbit's uterus to produce histologic changes (progestational changes) resembling those observed during early pregnancy and pseudo-pregnancy.[36] The term PROGESTIN is retained "as a general term to indicate the substance (and other chemically allied substances having similar action, in case any such compounds are subsequently discovered) without reference to the state of chemical purity, for convenience in clinical and biologic speech and writing." By derivation this term means that the substance is a ketone belonging to the class of sterols and favoring gestation. In contradistinction to the naturally occurring estrogenic substances, of which at least seven have been isolated in a crystalline form, there is at the present time only one progesterone. Thus, when reference is made to the pure hormone of the corpus luteum it is anticipated that such names as corporin, progestin, lipo-lutin, and luteosterone previously used by different writers will be replaced by the new term.

[35] Council of Pharmacy and Chemistry: Nomenclature of estrus-producing compounds. J. A. M. A., 107: 1221-1223, October 10, 1936.

[36] Council of Pharmacy and Chemistry: Nomenclature of corpus-luteum hormone. J. A. M. A., 106: 1808-1809, May 23, 1936.

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In addition to their extraction from natural sources the estrogenic hormones and the corpus luteum hormone have been synthesized. To supplement the estrogens, which have been available for some time, progesterone is now commercially available. The use of estrone in the treatment of menopausal symptoms and juvenile gonorrheal vaginitis is well established. In the treatment of the latter, Novak states that the administration of the estrogen by vaginal suppositories is more effective than subcutaneously.[37] The recent work of Moore and his associates shows that estrogens are readily absorbed through the skin.[38]

In disorders of the menstrual interval and flow the institution of proper therapy is dependent upon determination of whether the cause lies in the ovary, the pituitary or other endocrine glands, or is incident to some constitutional disorder. If the disorder is determined to be of an endocrine nature, then the method of hormonal treatment indicated is either direct substitutional or indirect stimulative. The administration of estrone or progesterone when the fault is determined to be in the ovary is substitutional. The giving of a gonadotropic hormone, however, is stimulative as it is hoped thereby to cause the ovary to produce its own hormones. Needless to say, if the trouble lies in the pituitary, then the giving of the gonadotropic hormone becomes substitutional. In amenorrhoea and oligomenorrhoea, on the basis of its ability to build up the endometrium as well as induce tissue growth, the estrogens have frequently been given, alone or combined with progesterone and thyroid, but in summarizing the treatment of these disorders Novak reports the results as unimpressive.[37] Frank and his co-workers are equally unimpressed by the effects of treatment with either the estrogens or the gonadotropic substances.[39]

The successful treatment of nausea and vomiting incident to pregnancy with estrogenic preparations in 48 out of 50 cases has been reported by Hawkinson.[40] The rationale of this form of treatment is based on the usually associated estrone deficiency in this condition as noted by Smith and Smith.[41] It is yet too early to pass judgement on this use of the hormone.

Now that progesterone is commercially available, its use in a number of clinical conditions where formerly the lutenizing gonadotropic hormone was used is proving highly successful. In dysmenorrhoea,

[37] Novak, E.: A brief epitome of gynecologic endocrinology and organotherapy. A. J. Obst. & Gynec., 32: 887-895, November 1936.

[38] Moore, C. R., Lamar, J. K., and Beck, N.: Cutaneous absorption of sex hormones. J. A. M. A., 111: 11-14, July 2, 1938.

[39] Frank, R. T., Goldberger, M. A., Salmon, U. J., and Felshin, G.: Amenorrhea: Its causation and treatment. J. A. M. A., 109: 1863-1869, December 4, 1937.

[40] Hawkinson, L. F.: Nausea and vomiting of pregnancy. Minn. Med., 19: 519-524, August 1936.

[41] Smith, G. V., and Smith, O. W.: Further quantitative determination of prolan and estrin in pregnancy with especial reference to late toxemia and eclampsia. Surg. Gynec. & Obst., 61: 27-35, July 1935.

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owing to its inhibitory action on uterine contractions, it has proved the most successful treatment to date. Here, the cause is frequently an imbalance between estrone and progesterone. Novak recommends 1 rabbit unit per day starting 3 to 4 days before the expected menstrual period and continued until the flow is well established.[37] During the same time 100 to 200 units daily of one of the pregnancy urine preparations is beneficial.

In functional uterine bleeding it is now well established that the ovarian dysfunction concerned in this disorder consists of a failure of ovulation. Inasmuch as no corpus luteum is formed there is an absence of progesterone to offset or neutralize the effect of estrone. In menorrhagia and metrorrhagia also, there is apparently a dominance of estrogenic substances. In these conditions progesterone naturally suggests itself as the rational form of treatment and further, Israel states that in any type of dysfunctional uterine bleeding the estrogens are definitely contra-indicated in the treatment.[42] The dosage of progesterone in these conditions is still empirical and is only a substitutive form of treatment yielding temporary relief. In the treatment of functional bleeding associated with endometrial hyperplasia Wilson and Elden report satisfactory results using doses varying from 1/25 Rb. U to 3 or 4 Rb. U daily until bleeding was controlled.[43]

Maintenance of pregnancy, at least in the early months, is dependent upon the presence of an adequate amount of progesterone. When it was recognized that lack of this hormone would, and did, result in abortion in the absence of any other demonstrable pathology, the method of treatment was obvious. Its successful use in the treatment of threatened and habitual abortion has been reported by Kane,[44] Gershenfeld,[45] and Elden.[46] The dosage varies with the response of the patient, some requiring only 1/25 Rb. U every other day for 3 to 4 months, while others require 1 or more Rb. U daily and for a longer period.

Before leaving the discussion of the corpus luteum hormone a word should be said concerning the manner and form of its excretion. In 1936 Bloch reported he was unable to demonstrate the presence of progesterone in 500 cc of blood from women 4 to 6 months pregnant.

[37] Novak, E.: A brief epitome of gynecologic endocrinology and organotherapy. A. J. Obst. & Gynec. 32: 887-895, November 1936.

[42] Israel, S. L.: Treatment of dysfunctional menstrual disorders. Endocrinology, 22: 253-261, February 1938.

[43] Wilson, K. M., and Elden, C. A.: Some points in treatment of edometrial hyperplasia by progesterone therapy. Am. Jour. Obst. & Gynec., 32: 194-200, August 1936.

[44] Kane, H. F.: Use of progesterone in combating habitual abortion. Am. J. Obst. & Gynec., 32: 110-113, July 1936.

[45] Gershenfeld, D. B.: Treatment of threatened and habitual abortion. J. Med. Soc. N. J., 34: 508-509, August 1937.

[46] Elden, C. A.: Treatment of habitual abortion by progesterone. Am. J. Obst. & Gynec., 35: 648-652, April 1938.

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Also, he was able to recover less than 1 Rb. U in 800 cc of sow's blood.[47] In this article he states that other investigators had been able to obtain only one unit in 20 liters of urine taken during pregnancy and the last half of the menstrual cycle. Later in the year, however, Venning and Browne [48] were able to demonstrate sodium pregnandiol glucuronidate, a physiologically inactive solid alcohol, in the urine of pregnant women and further study showed that this is the form in which progesterone is excreted.[49] Just where this break-down of progesterone occurs in the body is unknown. Nevertheless, by determining the pregnandiol content of urine we now have a method by which we can measure the functional activity of the corpus luteum other than by study of the endometrium, and determine duration of the corpus luteum activity. By a study of the urine of normal women they demonstrated that this substance is present only during the time of corpus luteum activity, that it appears in the urine within 48 hours of ovulation and that following its disappearance from the urine the next menstrual flow occurs in from 1 to 3 days. The total amount of pregnandiol normally excreted during the whole cycle appears to be from 40 to 55 mgm. Perhaps this estimation will throw some light on the problem of functional bleeding, habitual abortion, and sterility. If the formation of a corpus luteum is dependent upon the rupture of a graafian follicle with the extrusion of its ovum, then this would be an excellent method of determining whether or not ovulation had occurred.

Vitamin E

Vitamin E is such an indispensable factor to the successful termination of pregnancy that it is proper that we mention it in passing.

That this vitamin, abundantly present in the wheat germ, is essential for normal gestation has been conclusively shown. Lack of it in the diet of animals invariably leads to placental separation and death of the foetus. Among the women of India, Balfour and Talpade report that the incidence of premature births and stillbirths is three times greater in the south, where the diet consists mainly of milled rice, than in the north, where whole wheat is widely used.[50] Although it is hard to conceive of such a dietary deficiency among the people of the western world, several investigators have reported the successful use of this agent in the treatment of threatened or repeated spontane-

[47] Bloch, P. W.: Progestin content of blood. Endocrinology. 20: 307-310, May 1936.

[48] Venning, E. H., and Browne, J. S. L.: Isolation of water soluble pregnandial complex from human pregnancy urine. Proc. Soc. Exp. Biol. & Med., 34: 792-793, June 1936.

[49] Venning, E. H., and Browne, J. S. L.: Studies on corpus luteum function. 1. Urinary excretion of sodium pregnandial glucuronidate in the human menstrual cycle. Endocrinology. 21: 711-721, November 1937.

[50] Balfour, M. I., and Talpade, S. K.: Influence of diet on pregnancy and early infant mortality in India. Indian Med. Gazette. 67: 601-606, November 1932.

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ous abortion.[51 52 53 54] The way in which this vitamin acts to prevent premature termination of pregnancy is not known, but Shute believes that in the pregnant woman it acts by neutralizing the estrogenic substance, which when present in excess resists the intrusion of placental villi into the uterine wall.[55 56] In this way he postulates the mechanism of abortion, miscarriage, premature birth, and abruptio placentae. That vitamin E exhibits no estrogenic, gonadotropic, or luteinizing effects when tested on immature female, castrated adult female, or normal rats has been shown by the work of Saphir so its effect cannot be hormonal.[57]

Testis Hormone

Some agent capable of producing sexual rejuvenation has been the goal of man from ancient times. The ingestion of animal testis as an aphrodisiac and stimulant for many centuries after the beginning of the Christian era is a matter of record, but it was not until 1775 (Bordeu) that the concept of the testis as an organ of internal secretion was first advanced.[58] During the following years of the 18th and 19th centuries many investigators reported observations concerning the endocrine functions of the testis but it is only since 1927 that testicular hormones of sufficient purity and potency have been available to produce significant results in man.

In 1927 McGee obtained the first successful preparation of the male sex hormone from bull testes as demonstrated by its ability to repair the atrophy of secondary sex organs incident to castration, and also by its ability to promote comb growth in capons.[59] Later an extract with definitely potent androgenic properties was demonstrated in human urine [60] and in the blood and spinal fluid of man.[61] In 1931 Butenandt [62] obtained a pure crystalline substance from human male urine which exhibited androgenic properties, and in 1934 he and

[51] Vogt-Möller, P.: Treatment of habitual abortion with wheat germ oil (Vitamin "E"). Lancet, 2: 182–183, July 25, 1931.

[52] McGonigle, G. M. C. Vitamin "E" and fertility. Ill. Med. Jour., 67: 212–213, March 1935.

[53] Watson, E. M., and Tew, W. P. Wheat germ oil (Vitamin "E") therapy in obstetrics. Am. J. Obst. and Gynec., 31: 352–358, 1936.

[54] Cromer, J. K.: Wheat germ oil (Vitamin "E") in treatment of repeated spontaneous and threatened abortion; Preliminary report. Med. Ann. Dist. Col., 7: 145–148, May 1938.

[55] Shute, E.: Relation of deficiency of vitamine E to anti-proteolytic factor found in serum of aborting women. J. Obst. and Gynec. Brit. Empire, 43: 74–86, February 1936.

[56] Shute, E.: Early diagnosis of abruption placentae and its treatment with wheat germ oil. Am. J. Obst. and Gynec., 33: 429–436, March 1937.

[57] Saphir, W.: Vitamin "E" and the gonads. Endocrinology, 20: 107–108, January 1936.

[58] Bordeu, quoted by Rolleston: Endocrine organs in health and disease. Oxford University Press, London, 1936.

[59] McGee, L. C.: Effect of injection of lipoid fraction of bull testicle in capon. Proc. Inst. Med., 6: 242–244, 1927.

[60] Funk, G., and Harrow, B.: Male hormone. Proc. Soc. Exp. Biol. & Med., 26: 325–326, January 1929.

[61] McCullagh, E. P., McCullagh, D. R., and Hickens, N. F.: Diagnosis and treatment of hypogonadism in male. Endocrinology, 17: 49–63, January–February 1933.

[62] Butenandt, A.: Uber die chemische untersuchung der sexualhormon. Ztschr. f. angew. chem., 44: 905–908, 1931.

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Tscherning showed this substance to be an oxyketone and gave it the name ANDROSTERONE.[63] Later in the year Ruzicka and his coworkers prepared this substance synthetically from cholesterol.[64] In 1934 Butenandt and Dannenbaum were able to demonstrate a second androgenic hormone, but of much less potency, in male urine which was found to be a dehydro-androsterone.[65] In 1935 Ruzicka and Wettstein likewise prepared this substance synthetically from cholesterol.[66] In 1934 Gallagher and Koch demonstrated the hormone obtained from the testis of the bull to be many times more potent than that from the urine and also that they differed in that the testicular hormone was destroyed by alkali.[67] Thus from both the chemical and physiological aspects it was suggested that the two hormones were different. This was followed the next year (1935) by the isolation of a pure crystalline hormone from the tissue of the testicle by David and his associates which was alkali labile, compared favorably in potency with the most refined tissue extracts and was many times more effective on mammalian tissues than androsterone.[68] This substance was designated TESTOSTERONE and was almost immediately (1935) prepared synthetically from cholesterol by Ruzicka and Wettstein.[66]

In 1935, while working with the crystalline hormone from the testicle, David and his coworkers noted that the testicular tissue contained an acidic substance which was fat soluble and although itself not androgenic, nevertheless was capable of enhancing the androgenic properties of the other compounds. This same property was also shown to be possessed by certain of the higher fatty acids by Miescher, Wettstein, and Tschopp.[69] Studies of a series of fatty acid esters of testosterone have been made and it has been demonstrated that there are no toxic end products from the fatty acid moiety, and of those prepared to date, the most active by biological test is the propionate and secondly the acetate. Parkes also has shown that the addition of the higher fatty acids to testosterone makes it many times more effective and the action so prolonged that its use can be

[63] Butenandt, A., and Tscherning, K.: Uber androsteron-ein krystallisiertes männliches sexualhormon; isolierung and reindarstellung aus männerharn. Ztschr. f. physiol. chem., **229**: 167–184, 1934.

[64] Ruzicka, L., Goldberg, M. W., Meyer, B. H., and Eichenberger, E.: Zur kenntnis der sexualhormon: II. Ueber die synthese des testikelhormons (Androsterone) und stereoisomerer desselben dur abban hydrietes sterine. Helv. chim. acta., **17**: 1395–1406, 1934.

[65] Butenandt, A., and Dannenbaum, H.: Uber androsteron: Isollerung eines neuen; physiologisch unwirksamen sterin-derivate aus männerharn, seine verknüpfung mit dehydro-androsteron und androsten. Ztschr. f. physiol. chem., **229**: 192–208, 1934.

[66] Ruzicka, L., and Wettstein, A.: V. Künstliche herstellungs der männlichen sexualhormons transdehydro-androsteron und des androsten; 3,17-dious. Helv. chim. acta., **18**: 986–994, 1935.

[67] Gallagher, T. F., and Koch, F. C : Effect of alkali on testicular hormone. J. Biol. Chem., **104**: 611–617, March 1934.

[68] David, K., Dingemanse, E., Freund, J., and Laqueur, E.: Ueber krystallinisches männliches hormon aus hoden (testeron), wirksamer als aus harn oder aus cholesterin bereitetes androsteron. Ztschr. f. physiol. chem., **233**: 281–282, 1935.

[69] Miescher, K.; Wettstein, A., and Tschopp, E.: On the activation of testosterone. Chemistry and Industry. **55**: 238. 1936.

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restricted to twice a week without loss of effectiveness.[70] What it is that causes this increased activity is unknown, but apparently it is related to the rate of absorption. In passing it should be mentioned that testosterone with a high fatty acid added to it is not as effective as the esters of testosterone.

Thus under varying trade names we now have available for clinical use in the ascending order of their effectiveness the following pure hormones (1) dehydroandrosterone, (2) androsterone, (3) testosterone, (4) testosterone acetate and (5) testosterone propionate. Also we have androstine, the total extract (aqueous and lipoidal) of fresh whole testes of healthy bulls.

That there is a close interrelationship between the testes, the secondary sex organs, the development of the secondary sex characteristics and the pituitary has been clearly shown and as in the case of the estrogenic hormone, estrone, the androgenic hormone, testosterone, is under the control of the anterior lobe of the pituitary through the gonadotropic hormone. We know that following castration the prostate and seminal vesicles atrophy and we get an increase in the size and function of the hypophysis as well. Also we know that following hypophysectomy the prostate and seminal vesicles atrophy while, on the other hand, injections of the gonadotropic hormone, either from the pituitary or from pregnancy urine will produce growth of the sexual organs.

At the present time there is an increasing amount of evidence indicating that the adrenal cortex also plays a very important part in the function of the sex glands, both male and female. In the female, masculinization (virilism) accompanying adrenal cortical tumors is frequently noted and in 1936 Simpson, deFremery and MacBeth reported the finding of an excessive amount of the male hormone in the urine of 7 out of 11 women exhibiting virilism and 2 out of 3 pseudohermaphrodites.[71] Recently Simpson and Joll [72] as well as Lisser [73] have reported cases in which a tumor of the adrenal cortex in the male produced the opposite effects, that is, feminization characterized by gynecomastia and lactation. This condition is so rare that its very existence has been doubted. To date only six definite cases have been reported, but this counterpart to virilism is highly suggestive. Working along entirely different lines, Marker[74] has shown the close structural similarity between the sex hormones and

[70] Parkes, A. S.: Increasing effectiveness of testosteron. Lancet. 231: 674–676, Sept. 19, 1936.

[71] Simpson, S. L., deFremery, P., and MacBeth, A. L.: Presence of excess of "male" (comb-growth and prostate-stimulating) hormone in virilism and pseudo-hermaphroditism. Endocrinology. 20: 363–372, May 1936.

[72] Simpson, S. L., and Joll, C. A.: Feminization in male adult with carcinoma of adrenal cortex. Endocrinology. 22: 595–604, May 1938.

[73] Lisser, H.: Case of adrenal cortical tumor in adult male causing gynecomastia and lactation. Endocrinology. 20: 567–569, July 1936.

[74] Marker, R. E.: Sterols. XL. Origin and interrelationships of the steroidal hormones. J. Am. Chem. Soc. 60: 1725–1736, August 1938.

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adrenosterone, a compound from the adrenal cortex, with weak androgenic properties which was isolated in 1936 by Reichstein.[75] From this similarity he considers it to be the connecting link between the cortical hormones and the sex hormones and postulates a common precursor for both. But what this precursor is, how it is related, and its source, must await the isolation of a definitely proved pure cortical hormone and the determination of its chemical structure.

Thus the interrelationship of the testes, the adrenal gland and the pituitary is so close that any dysfunction in one member of this triad is inevitably manifest by changes in the others and reflected in the secondary sex organs and characteristics.

THERAPY OF THE TESTICULAR HORMONE.—In the use of the testicular hormones thereapeutically it must be remembered that an equilibrium exists between the function of the anterior lobe of the pituitary and the gonads. An increase in the output of the gonadal hormones inhibits the stimulating action of the pituitary on the gonad, whereas a decrease in the output increases it. It is evident, therefore, that theoretically, large doses of the sex hormone may produce gonadal damage. Also it must be remembered that a hormone has no direct action on the gland from which it arises and thus a curative effect in a case of gonadal insufficiency cannot be expected from their administration. Only the anterior pituitary gonadotropic hormone can bring about such a change. However, the specific sex hormones may be of value from a psychological and physical standpoint in stimulating the development of the secondary sex characteristics.

In the form of substitution therapy the male sex hormone naturally suggests itself in cases of eunuchism, hypogonadism, and impotency due to primary testicular deficiency. Its successful use in these conditions, as determined by development of secondary sex characters (change of voice, development of pubic, axillary and extremity hair, penile and scrotal growth), change in personality content, development of libido and penile erection has been reported by Vest and Howard[6] as well as Hamilton[76 77] and others.[61] At this time there is no method other than clinical trial by which to determine the amount of the hormone required to produce and maintain the desired results. In the castrate it varies with the age, prepubertal or postpubertal, or advanced adolescence and the state of physical development at the time of emasculinization. In the hypogonadal state it varies with the

[6] Vest, S. A., and Howard, J. E.: Clinical Experiments with the use of male sex hormones. I. Use of Testosterone propionate in hypogonadism. J. Urol. 40: 154–183, July 1938.

[61] McCullagh, E. P., McCullagh, D. R., and Hickens, N. F.: Diagnosis and treatment of hypogonadism in male. Endocrinology, 17: 49–63, January-February 1933.

[75] Reichstein, T.: Andrenosteron uber die berlandteile der nebennierenrinde. Helv. chim. acta. 19: 223–225, 1936.

[76] Hamilton, J. B.: Treatment of sexual underdevelopment with synthetic male hormone substance. Endocrinology. 21: 649–654, September 1937.

[77] Hamilton, J. B.: Induction of penile erection by male hormone substance. Endocrinology. 21: 744–749, November 1937.

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degree of testicular function remaining. In the cases reported by Best and Howard it required from 25 to 50 mgm of testosterone propionate a week, given in a single injection or biweekly.[6]

But while the foregoing conditions are comparatively uncommon, benign prostatic hyperplasia with its concurrent symptoms is frequent. Although the exact cause of this enlargement is still unknown the evidence is becoming increasingly conclusive that this is the result of an endocrine imbalance involving changes in the hypophysis and the gonads. The frequency with which the condition occurs at the time of the functional retirement of the testes is highly suggestive of this relationship. Funk, Harrow, and Lejwa found that men in the prime of life excreted from 4 to 5 times as much male hormone as men from 50 to 70 years of age.[78] This finding has been verified by Kochakian who also reported a similar reduction in the urine of patients with enlarged prostates.[79] Further, he was unable to demonstrate any male hormone in the urine of a castrate. Dorfman and his associates demonstrated in children from 6 to 16 years of age that prior to puberty the male hormone excretion was only about one seventh that present after puberty which further confirms the idea that the testicular hormone is in some way connected with prostatic development.[80] With the loss of the well-recognized inhibitory effect of the gonadal hormone on the gonadotropic activity of the hypophysis in later life, it is easy to understand that the development of prostatic hypertrophy at this time should be considered related to testosterone production and that treatment directed toward the replacement of the testis hormone would prevent its enlargement.

The general consensus of opinion at this time is that clinical improvement of a very satisfactory kind does follow recourse to hormonal treatment. In 1936 Lower and McCullagh reported the relief of symptoms in 63.1 percent of 76 patients treated with dessicated whole beef testes.[81] In 1937 Bergmann reported gratifying success in a series of 69 patients complaining of fatigue, insomnia, frequent, and difficult micturition and perineal discomfort following the use of testicular extracts two to three times a week.[82] Walther and Willoughby are also gratified with the clinical improvement in their 15 cases using, in some, androstine, and in others, testosterone propionate.[83]

[6] Vest, S., A., and Howard, J. E.: Clinical Experiments with the use of male sex hormones. I. Use of Testosterone propionate in hypogonadism. J. Urol. 40: 154–183, July 1938.

[78] Funk, C., Harrow, B., and Lejwa, A.: Male hormone. Proc. Soc. Exper. Biol. & Med., 26: 569–570, April 1, 1929.

[79] Kochakian, C. D.: Excretion of male hormone I. Endocrinology. 21: 60–66, January 1937.

[80] Dorfman, R. I., Greulich, W. W., and Solomon, C. I.: Excretion of androgenic and estrogenic substances in urine of children. Endocrinology. 21: 741–743, November 1937.

[81] Lower, W. E., and McCullagh, D. R.: Endocrine therapy of benign prostatic hypertrophy. Med. Clin. N. A. 19: 1949–1957, May 1936.

[82] Bergmann, V. H.: Prostatic hypertrophy as a definite endocrine problem. J. Missouri State M. Assn. 34: 119–121, April 1937.

[83] Walther, H. W. E., and Willoughby, R. M.: Hormonal treatment of benign prostatic hypertrophy, J. Urol. 40: 135–144, July 1938.

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Needless to add, this form of treatment is so recent and the cases treated have been under observation for such a short time that this work must still be considered as in the experimental stage. The water soluble testicular hormone "inhibin" postulated by Lower and McCullagh in 1936 has not yet been isolated.[81]

Insulin

The primary use of insulin is still in the treatment of diabetes and its use in this condition requires no discussion here. In the treatment of the complications of diabetes it remains our only agent, the newer insulin compounds, protamine insulin, protamine zinc insulin, and crystalline insulin, because of their slow rate of absorption, being definitely unsuitable and contraindicated.

Its recent introduction as a therapeutic agent in the treatment of schizophrenia has caught the fancy of the general public as well as the medical profession.

Because of the chronicity and comparatively low direct mortality of schizophrenia Hoskins has stated that one-fifth of all the hospital beds in the United States are occupied by schizophrenic patients.[84] Naturally any form of therapy which offers the individual, his family, and the community some relief from such a serious social and economic problem would be received with open arms.

Insulin in the treatment of schizophrenia.—In 1933 Sakel [85] introduced the insulin-shock treatment of schizophrenia and because of the favorable reports by him and others it has been introduced into numerous clinics and institutions in this country and abroad since 1936.[85 87 88 89 90 91] A detailed report on this therapy, by McDaniels and Hogan, appears elsewhere in this issue. So far none have reported such favorable results as Dussik and Sakel [86] or Muller.[87 88] Although Rosenberg and Moersch are skeptical of its value, most investigators believe this method of treatment to be a promising approach to the problem, especially in the early case, although not

[81] Lower, W. E., and McCullagh, D. R.: Endocrine therapy of benign prostatic hypertrophy. Med. Clin. N. A. 19: 1949–1957, May 1936.

[84] Hoskins, R. G.: Dementia Praecox; simplified formulation. J. A. M. A. 96: 1209–1211, April 11, 1931.

[85] Sakel, M.: Schizophreniebehandlung mittels insulin-hypoglykämie sowie hypoglykämischer schocks. Wien. med. wchnschr., 84: 1211, November 3, 1934; 84: 1265; 84: 1299; 84: 1326; 84: 1353; 84: 1383; 84: 1401; 85: 35; 85: 68; 85: 94; 85: 121; 85: 152; 85: 179, February 9, 1935.

[86] Dussik, K. T., and Sakel, M.: Ergebnisse der hypoglykämieschockbehandlung der schizophrenie. Ztschr. f. d. ges. Neurol. u. Psychiat., 155: 351–415, 1936.

[87] Müller, M.: Die insulinschocktherapie der schizophrenie. Schweiz. med. wchschr., 66: 929–935, 1936.

[88] Müller, M. Die insulinshockbehandlung der schizophrenie. Nervenartz., 9: 569–580, 1936.

[89] Glueck, B.: Hypoglycemic state in treatment of schizophrenia. J. A. M. A., 107: 1029–1031, September 26, 1936.

[90] Rymer, C. A., Benjamin, J. D., and Ebaugh, F. G.: Hypoglycemic treatment of schizophrenia. J. A. M. A., 109: 1249–1251, October 16, 1937.

[91] Wortis, J.: On response of schizophrenic subjects to hypoglycemic shock. J. Nerv. & Ment. Dis., 84: 497–506, November 1936.

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without its dangers.[92] These dangers have been summarized by Cameron and Hoskins as—

(1) The possibility of delayed relapse into hyperinsulinism and failure to recognize it,

(2) Collapse during a convulsive seizure,

(3) Aspiration pneumonia and

(4) Complications from the low body temperatures sometimes produced.

(5) Other contingencies which occasionally arise, but which generally are transitory and leave no residuals are hemiplegia, localized paresis, spasm of the glottis and pulmonary oedema. Those symptoms rapidly disappear with the intravenous administration of glucose.[93]

To date there has been no satisfactory or acceptable explanation as to the reason why insulin, or for that matter the convulsant drugs, should produce any effect on the patient suffering from dementia praecox. There are a number of theories, one of which is that it stimulates general metabolism and liver function and thereby induces an elimination of toxins. Another is that by removal of the food supply of the cells by producing a hypoglycemia the functional activity of the brain cells is temporarily impaired and the abnormal thought patterns blocked. With restoration of full function, the abnormal process having been checked, more normal processes are allowed to emerge—a process analogous to digitalization in auricular fibrillation. A third is that it is purely biochemical in nature, producing a change in metabolism and endocrine balance, which in turn produces a violent stimulation of the controlling mechanisms of the sympathetic and parasympathetic nervous system.

As yet it is too early to properly evaluate this form of therapy. It is definitely not a specific. However, any therapeutic measure which offers any degree of success or opens up other avenues of approach is certainly worthy of the most thorough investigation. At this time it appears justifiable to conclude that the best results are obtained in the early cases, and that where successful, the period of hospitalization is materially reduced. In estimating the clinical value of any therapeutic measure employed in the treatment of this condition the duration and quality of remissions and speed of recovery following such therapy must be evaluated cautiously since spontaneous remissions and recoveries are variously estimated at from 20 to 40 percent.[90] As so frequently happens with the introduction of new drugs or new methods in the treatment of disease, the first reports are enthusiastically received and the literature immediately following is highly optimistic and frequently not critical. Then, as more careful observations are made, the pendulum swings to the other extreme.

[92] Rosenberg, E. F., and Moersch, F. P.: Insulin-hypoglycemia treatment of schizophrenia: results in treated and untreated cases. Proc. Staff. Meet., Mayo Clin., 13: 113-116, February 23, 1938.

[93] Cameron, D. E., and Hoskins, R. G.: Experiences in insulin-hypoglycemia treatment of schizophrenia. J. A. M. A., 109: 1246-1249, October 16, 1937.

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At the present time articles are beginning to appear which cast considerable doubt upon the value of this procedure. What the final result is to be, whether or not insulin shock therapy has any place in medicine, must await carefully evaluated results on the basis outlined.

Protamine-zinc Insulin

Before we can understand the mechanism of diabetes we must first determine the physiology of carbohydrate metabolism. The demonstration that insulin, the hormone from the pancreas, is one of the controlling mechanisms is only the first step in this direction, albeit, a very important one. Increasing studies of this problem show that various endocrine glands other than the pancreas, including the pituitary, the adrenals, and the thyroid, and acting through the liver and body tissues, are closely allied with the regulation of carbohydrate production and consumption. These numerous factors, harmoniously coordinated, maintain the blood sugar at a more or less constant level. The exact mechanism by which each exerts its influence is still undetermined. Houssay offers the suggestive concept that, since in all diabetes there is an insufficiency of insulin in relation to the needs of the organism, we consider the hormone of the pancreas as the antidiabetic factor and the hormones of the anterior pituitary, adrenals, and thyroid as antagonistic factors in the regulation of the blood-sugar level.[94] Under this concept the fault might not lie in the pancreas at all. It is conceivable that the amount of insulin secreted might be normal or even increased, yet through failure of the other endocrine factors to function in a harmonious equilibrium in response to the body needs, the blood sugar is not maintained at a normal level and a condition simulating diabetes may be produced.

In a normal state of health the flow of insulin is continuous, smooth and at all times is so exactly balanced with the needs of the body that at no time is there a relative want as manifested by a hyperglycemia and glycosuria, or a relative excess as indicated by hypoglycemia and its attending symptoms. Insulin by injection, on the other hand, acts in a fleeting manner producing an early marked fall in the blood sugar followed by a rather rapid rise. The time relation of its action and duration are remarkably constant and independent of the size of the dose. Usually within 30 minutes the blood sugar begins to fall, reaches its maximum in about 3 to 4 hours and in 6 to 8 hours its effects have worn off.

Realizing this inability of regular insulin to simulate the normally functioning pancreas in maintaining a more or less normal blood sugar with consequent freedom of glycosuria, clinicians have, since its introduction in 1922, felt the need for an insulin of slower and more pro-

[94] Houssay, B. A.: Diabetes as a disturbance of endocrine regulation. Am. J. Med. Sc. **193**: 581–606, May 1937.

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longed action. Joslin has vividly described this feature of insulin inefficiency. Accepting 8 hours as the maximum duration of activity for a single dose he reminds us that on two doses the patient is protected for only 16 hours, or two-thirds of the day. Considering that the life expectancy of the diabetic "is certainly 12 years for all, and for the average new case more likely 20 years, it is evident that for 4 to 7 years the diabetic treated with regular insulin would be out of control." [95] With this need of a more lasting insulin effect in mind, experiments employing oil suspensions, gelatin implants, inunction, vasoconstrictor agents, etc., have been tried, but it was not until 1936 that Hagedorn and his associates announced that they had finally succeeded in modifying insulin by the addition of protamine so that the effects of a single injection were prolonged, lasting 12 to 16 hours.[96] Later it was shown that the addition of zinc to this protamine insulin would further prolong the duration of its effectiveness to 24 hours or more with the greatest effect appearing 12 or more hours after administration.

This prolonged duration of absorption appears to more nearly approach the natural method of continuous secretion. In this absorption factor lies the advantage as well as disadvantage of modified insulin. By its less rapid but more persistent action the blood sugar fluctuations, present under regular insulin treatment, are smoothed out, the number of injections decreased, and frequently the total unitage cut. Favorable reports using either the protamine insulinate or the protamine zinc insulin have been made by numerous observers.[97] [98] [99] [100] [101] For the fresh case Joslin states this modified insulin is ideal.

However, many observers while recognizing the advantage of the slower rate of absorption of protamine zinc insulin are not convinced that this advantage outweighs its definite disadvantages, or that regular insulin can be completely eliminated in the routine of treatment.[102] [103] [104] [105] Because of its prolonged action there is the danger

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of over-dosage owing to its accumulative effect especially at the beginning of treatment which necessitates a more prolonged and careful study of the patient to establish the maintenance dose. This period of stabilization should be carried out in a hospital. Because of its delayed action, the period of maximum effectiveness is from 12 to 18 hours after injection. Consequently when a dose is given before breakfast there is the resulting danger of hypoglycemia and coma developing during the sleeping hours. If the patient is given an adequate dose of the protamine zinc insulin to keep him free of glycosuria during the early morning hours, then the dosage given before breakfast will have no effect on the morning meal and glycosuria will develop. To overcome this disadvantage many now prescribe, in addition to the dose of protamine, a dose of regular insulin in the morning to function during the lag period of protamine. Also the reactions from an over-dose of protamine zinc insulin come on insidiously and frequently without the warning symptoms that the patient recognizes. Some observers say these are milder than under regular insulin, but others state that, although less frequent, they are more prolonged, more severe and more difficult to control.[106]

At this time we can only say that protamine or protamine zinc insulin are not the final solution to the problem of the treatment of diabetes. The active principle in the control of the disorder is still insulin, and the fundamentals of treatment are not changed.

For those complications of diabetes, infection, coma, preoperative and postoperative management, the use of regular insulin is the only form of therapy that should be considered.

Conclusion: Protamine zinc insulin is a definite therapeutic advance if one has definite knowledge of its advantages and limitations and gives special attention to the rearrangement of the diet in order to avoid insulin reactions.

Crystalline Insulin

Since the discovery of insulin 18 years ago unremitting effort has been made to improve the product. One line of endeavor, besides the combining of insulin with protamine discussed above, has been to produce a purified form of insulin by crystallization. This was first accomplished by Abel in 1926 using a highly purified form of commercial insulin, but the yield was so small that its use clinically was impracticable.[107] In 1936, however, a method of crystallization which is reported as commercially practicable was developed by Dr. Melville Sahyum of Detroit. Several reports on the clinical use of

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this form of insulin have appeared in the literature.[108 109 110 111] The general concensus of opinion regarding this product is that its onset of action is slower than with regular insulin, but faster than in protamine insulin. Further, the duration of its effect is longer than with regular insulin but considerably less than with the protamine compounds. Clinical evidence indicates that there is a gradual lowering of the blood sugar for 6 to 8 hours following the administration of crystalline insulin after which there is a gradual rise. Thus in crystalline insulin we have an agent which, based on time of maximum effect and duration of absorption, stands about midway between regular insulin and protamine zinc insulin.

Experience indicates that it can be used in any type of diabetes requiring insulin except in diabetic coma. Because of its delayed action it reduces the fluctuations of the blood sugar curve, and at the present time the impression is that unit for unit it is more effective than regular insulin. This is based on the observation that because of impurities present in regular insulin, not present in crystalline insulin, there is frequently a preliminary hyperglycemia following the administration of regular insulin and on the fact that crystalline insulin is absorbed more slowly.[112] Because of its slower action, patients, previously on 2 or 3 injections of regular insulin, frequently can be reduced to one injection of crystalline insulin a day. Where a patient has been on regular insulin previously, Altshuler recommends that, on transferring to crystalline insulin, two thirds of the previous daily dosage be given, divided into 2 equal doses, the first about half an hour before breakfast and the second 10 to 14 hours later, either before or after the evening meal depending upon the eating schedule of the patient.[111]

Also because of its slow action, insulin reactions are less common with this preparation than with regular insulin, and when they do occur they come on more slowly and are unassociated with shock. In the few cases in which such reactions have been reported they have been easily controlled, but as with protamine insulin the danger of hypoglycemic coma developing during the sleep is a definite possibility and a decided disadvantage. It has been noted that with this compound, as with the protamine, patients frequently develop a fairly well marked hypoglycemia without any symptoms whatsoever.

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Adrenal Gland

The anatomical division of the adrenal gland into two parts, the medulla and cortex, with the elaboration of two distinct hormones, epinephrine and cortin respectively, is well known. The clinical use of the medullary hormone, epineprine, is well established. But the relationships and place of the cortical hormone in the body economy is still unsettled, although as a result of recent work a considerable amount of knowledge as to its action is available.

From both clinical and experimental evidence it is evident that there is a very definite relationship between the anterior pituitary and the adrenal cortex. Also, the fact that adrenal cortical hypertrophy does not occur in hyperpituitary states where there is an absence of the thyroid gland is indicative of a thyroid-adrenal interrelationship. Further, the demonstration of a substance in the adrenal cortex with definite androgenic properties, as well as the sex reversal of secondary sex characteristics associated with some adrenal cortical tumors is highly suggestive of a definite adrenocortico-gonadal relationship. This is further indicated by the fact that except for the gonad and the adrenal cortex hormones, the hormones of the ductless glands are unrelated as to chemical structure.

That there is an antagonistic relationship also between the hormones of the adrenal cortex and of the pancreas has been conclusively demonstrated experimentally by Long, Fry and Thompson,[113] Lukens and Dohan [114] and others. In experimentally induced diabetes (partial pancreatectomy) the removal of the adrenal cortex ameliorates the diabetic symptoms, whereas the administration of the cortical hormone increases their severity. How it is that cortin enters into the process of carbohydrate metabolism is not definitely known. Kendall believes that "the key to the interpretation of some of the influences exerted by epinephrine, insulin and cortin" lies in the changes in mineral metabolism.[115] Experimental evidence indicates that cortin, through its influence on the metabolism of potassium, indirectly effects the metabolism of carbohydrates.[116] The assimilation of glucose by the tissue cells appears to be in the form of a potassium-hexose-phosphate, the potassium ion coming from the potassium stored in the blood, which storage is regulated by cortin through the latter's control of the renal excretion of electrolytes. As yet this work is still in the experimental stage, but the results are highly suggestive.

For some time it has been known that in adreno-cortical insufficiency

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there is an excessive excretion of sodium associated with retention of potassium which can be controlled by the administration of cortin.[117] Also it has been demonstrated that adrenalectomized dogs could be maintained in good health indefinitely on a diet high in sodium chloride if combined with sodium bicarbonate and sodium citrate.[118] Later it was shown that the blood potassium could be maintained at a normal level in cases of cortical insufficiency if the potassium intake were restricted.[119 120] Experimentally it was also shown that the administration of even moderate amounts of potassium to the diet resulted in an increase of this ion in the blood plasma and was followed by symptoms of toxemia and death.

On the basis of this work has been developed the modern dietary treatment of Addison's disease. It is no longer necessary to give cortin continuously as substitutional therapy. Cortin is now reserved for treatment in the acute toxic stage, the crisis, where, in addition to the disturbed physico-chemical equilibrium incident to the loss of sodium with resulting dehydration, we also have superimposed a toxemia from potassium. Cortin apparently through its action on the absorptive elements of the renal tubule, controls or prevents the excessive excretion of sodium and induces excretion of potassium.

Further, except in the presence of diabetes, toxic symptoms from the administration of cortin have not been noted. Apparently in the normal individual the pancreas is capable of elaborating sufficient insulin to counteract any effect of a temporary increase in cortin. Because it is apparently harmless, the extract of the adrenal cortex has been recommended and tried clinically in numerous and sundry conditions. But apparently the hormone of the adrenal cortex is in some way significantly linked with the factors incident to the production of immunity to certain pyogenic infections. In 1932 Swingle and Pfiffner showed that adrenalectomy increased the susceptibility of animals to pyogenic infections.[121] On this basis the use of the adrenal cortical hormone to increase the immunologic response and to improve the lowered resistance incident to bacterial intoxication, both acute and chronic, has been reported by several observers.[122 123 124]

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Pottenger and Pottenger have used adrenal cortical substances in the treatment of tuberculous patients who suffered marked malaise and lack of vigor, some with toxemia and others without, and noted an improvement in their vigor, a lessening of their fatigue, and an apparent beneficial effect on the process of the disease.[125] This confirms the previous observations of Thompson and Whitehead.[126]

In 1933 Kemp summarized the results of adrenal cortical therapy on approximately 200 patients suffering from toxemia of pregnancy who were treated by various physicians. Complete relief or definite improvement was obtained in 85.6 percent of the cases.[127] In 1935 Stemmer also reported its successful use.[128] Freeman and his associates in 1937 reported they had treated 78 pregnant women showing varying degrees of toxemia with remarkable improvement in every case.[129] In the vomiting of pregnancy, the obvious starvation, with loss of fluids and chlorides and deranged metabolism has led to the adoption of glucose and saline intravenously as more or less standard treatment. The beneficial effect of the adrenal cortical hormone may be explained on the basis of its influence on inorganic salt balance. The dosage used depends upon the severity of the individual case and is combined with hydration therapy. Improvement occurs in from 2 to 7 days.

Adrenal cortical therapy has been advocated in the treatment of asthenia on the basis that the symptomatology—weakness, easy fatigability, cardiac instability, hypotension, gastro-intestinal instability, and all the other varied complaints—might in reality represent subclinical forms of adrenal cortical insufficiency. However, in view of the frequently associated neurasthenic component present in these individuals, the reported beneficial effects must be accepted cautiously since frequently these patients show temporary improvement following any type of therapy, especially if it is combined with well directed psychotherapy.

RECENT ADVANCES IN THE KNOWLEDGE OF THE VITAMINS

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That a diet may be entirely adequate with regard to calories and proteins and may be inadequate for maintenance and growth unless it contains accessory food substances, the vitamins, is now universally recognized. Drummond defines vitamins as essential constituents of

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the diet, organic in nature, incapable of synthesis in the body, and effective in playing a part in the maintenance of the normal functioning of the tissues in amounts minute by comparison with those of the foodstuffs which supply material and energy. The term vitamin has reference to the fact that they are essential to life and also that some of them, but not all, contain nitrogen. The name was given by Funk who was one of the earliest workers in the field; and one of the first to discover that there were such factors in the diet.

The development of certain disorders, when deficient diets were fed, led to the discovery of the necessity of these factors. Our original observations were made on man and the recognition of scurvy and beriberi and the protective diets necessary are cornerstones in our knowledge of the vitamins. These early observations have been proven, repeated, clarified, and amplified by animal experimental work. The science of nutrition has developed and pushed our knowledge of the vitamins ahead with a bewildering rapidity. We no longer speak of vitamin B but of the B complex, for as many as 12 factors have been described. Vitamin C apparently has a copartner in citrin (vitamin P). Investigation indicates that many of the vitamins act in fundamental biologic processes, as factors in oxidation and reduction, and that some of these necessary substances as they occur in food are not vitamins in their final form but are precursors of the true vitamin.

While the flood of experimental evidence coming from the nutrition laboratory, based on animal work, points the way, we must carefully scrutinize these reports. Animal results may not, in every case, unequivocally link the substance with deficiency disease in man. A number of factors in the B complex have no clinical application in man, though their absence produces definite deficiency disease in certain experimental animals.

Clinical observation, then, is most important in the deficiency diseases. For example, we know little of dietary requirements in disease with reference to the vitamins. The normal resistance of the human organism to vitamin deficiencies is known to be remarkable. In fact it appears almost that some independent disease must be acquired before avitaminosis becomes manifest, or if present in minor degree before, now becomes greatly accentuated. The vitamin needs of the body in disease are obviously very different from those in health. Vitamins may be ingested but not absorbed in altered conditions of the gastro-intestinal tract such as sprue or chronic dysentery. They may be lost by diuresis or diarrhea. The need may be vastly greater as metabolism increases. Portal obstruction, or pathology in the intestinal lymphatic system, may interfere with their absorption or storage. A normal flow of bile is required for absorption of fat soluble

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vitamins, just as bile acids and salts are necessary in emulsification of lipoid substances.

Advance in the field of vitamins rivals the progress in the endocrines. As in that sphere, much of the effort in the study of the vitamins has been directed toward the isolation in pure form of these substances. Where this has been accomplished, study of the chemical structure is possible and in some instances synthesis of the pure vitamin has followed. A few of the important recent advances taken from the current reviews are here given. The symposium on vitamins published in the J. A. M. A. during 1938, which is to be published shortly in book form, presents an exhaustive report on our present knowledge of the vitamins.

VITAMIN A.—Though not definitely known, the function of vitamin A appears to be that of an oxidation, reduction catalyst. This vitamin has been called the epithelial protective vitamin and has also been indicated as an anti-infection element. Ground for these concepts lies in the observation that vitamin A is probably necessary for the continued health of all tissues of epiblastic origin. Thus the brain and central nervous system, the retina, the skin and all its glands, such as tear, sweat, sebaceous, also salivary glands, as well as the mucous membranes of the mouth and the vagina, all being of epiblastic origin, require vitamin A for normal function. It also appears that this vitamin is needed for health of the mucous membrane of the intestine. It seems to play also some part in fertility and in other process of reproduction. Some observations indicate that it may be necessary for the hematopoietic system, but this is doubtful.

The absence of vitamin A in the diet then predisposes to infections in general and causes certain definite and specific diseases such as xerophthalmia, phrynoderma or toad skin, and night blindness.

It has been known for some time that *beta* carotene, the yellow-red plant pigment, will supply vitamin A deficiency and is equal to the potency of the colorless vitamin A as found in the fish-liver oils. There are four of these provitamins, *alpha*, *beta*, and *gamma* carotene and kryptoxanthin, but the *beta* form has twice the potency of the other carotenes. It has now been demonstrated that these substances are very similar in chemical structure. The crystalline vitamin has been isolated and more recently pure vitamin A has been synthesized. Its chemical structure is that of a primary alcohol. It forms esters with bile acids and circulates in the blood and lymph in the ester form.

The liver stores vitamin A as an ester of the primary alcohol and it has been demonstrated that in liver injury large amounts of this vitamin are lost in the urine. The vitamin A content of cirrhotic liver has been shown to be abnormally low.

VITAMIN B complex.—A considerable number of elements in the vitamin B complex have been postulated from experimental work on

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animals. A number of these appear specific for the laboratory animals but have not been demonstrated to be essential in man. Of the elements of the B complex which have been studied, vitamin B_1, ribo-flavine or B_2, and nicotinic acid appear to be connected with deficiency in man. These three have been shown to be definite chemical entities.

Vitamin B_1 (thiamin) has been synthesized and is usually dispensed as thiamin chloride. Kidney, liver, and heart apparently act as storage depots for vitamin B_1 though their storage capacity is low and definitely limited. In the metabolism of carbohydrates pyruvic acid is a normal intermediary product. This normal intermediary product appears to accumulate in abnormal quantities in the blood of patients suffering from beriberi. The administration of thiamin reduces pyruvic acid to normal apparently by enzymatic removal of the carboxyl group. Vitamin B_1 is essential in man, animals, and even in plants, where it represents one of the auxins essential for proper growth of seeds and roots. It is also essential in bacterial growth though it can be synthesized by them.

Vitamin B_2 is commonly called riboflavin. It was first isolated from milk as lactoflavin. It appears to have a number of functions but only one has been definitely established. Study indicates that it is an essential constituent of the yellow oxidation enzyme of Warburg and that it is definitely essential in the oxidation processes of the cell. Though previous work has indicated that B_2 deficiency is operative in pellagra as well as in sprue, some recent observations raise a doubt in relation to its importance in pellagra.

Nicotinic acid has been demonstrated to be effective in curing black tongue of dogs. This disease is the homologue of human pellagra. In the use of this substance in cases of pellagra it has been demonstrated that the cutaneous lesions and other symptoms of pellagra are markedly benefited by it. It appears that this clinical benefit is due to the effect that nicotinic acid has upon the porphyrinemia and porphyrinuria of pellagra.

Photosensitization produced by hematoporphyrin has been demonstrated in animals. After a porphyrin injection, albino guinea pigs die from exposure to ultra-violet light though they remain apparently quite normal if protected from the light. When mixed with serum proteins such as solutions of fibrinogen or serum albumin and exposed *in vitro* to ultra-violet light in the presence of oxygen, hematoporphyrin quickly hydrolized these proteins setting free peptones and other products from them. It is probable that histamine is one of these products. It may be that similar action occurs in the blood or skin. Histamine causes somewhat similar symptoms. The symptoms of erythema and itching are similar to those of anaphylactic shock in guinea pigs. Possibly histamine is set free from the blood proteins

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in the capillaries when light, oxygen, and hematoporphyrin coexist and exerts its toxic action on the skin in the capillaries of which it has been set free.

Nicotinic acid also inhibits the porphyrinuria of liver damage, lead poisoning, roentgen sickness, and a number of other conditions. It has been stated that nicotinic acid is either the P-P (pellagra-preventive) vitamin or a provitamin of this factor or that it may be conjugated with other substances in the body to form a more complex essential substance. It is highly significant that each molecule of Warburg's respiratory enzyme contains a molecule of nicotinic acid. Though nicotinic acid almost miraculously clears the symptoms of pellagra, it has been observed that patients continued on pellagra deficient diets, with only nicotinic acid added in adequate quantity, may after a time relapse. This suggests that there may well be other important elements in pellagra prevention.

Some of the other substances in the vitamin B complex, of importance in animals, but not yet demonstrated to be so in man are: B_3—necessary for normal nutrition in pigeons, B_4—prevents a specific paralysis in rats and chicks, B_5—maintains normal weight in pigeons, B_6—prevents dermatosis in rats, B_7—prevents digestive disturbances and diarrhea in pigeons, and a number of other factors on which our knowledge is even less definite.

VITAMIN C, or ascorbic acid, is a carbohydrate derivative, an oxidation product of the hexose sugar, mannose. It appears that this scurvy-preventing vitamin acts in the cell by virtue of its reducing properties, that is, like other vitamins it is one of the respiratory enzymes of the body. Its stability in the blood appears to be maintained by glutathione. Visible light destroys vitamin c in milk. Vitamin c may be detected in urine and in sweat.

Its presence in large quantities in the cortex of the adrenal in a free or actively reducing state, and in the medulla in an inactive form, also its presence in the pituitary and the gonads, points to some important function it plays in these organs. It is much reduced in quantity in the adrenal after strenuous muscular work.

The ability of the body to store vitamin c is definitely limited and the supply must be relatively constant, though quantities beyond a wise nutritional margin produce no benefit. The needs of the body, or the rapidity of loss, appear to be increased in pregnant and nursing women, in gastro-intestinal disease, in diseases of the liver, and in a number of other pathological processes. In these conditions massive doses of vitamin c may be required.

VITAMIN P.—It has been demonstrated that lemon juice is more effective in curing scurvy than pure vitamin c (ascorbic acid). A substance has been isolated from lemon juice and red peppers and termed vitamin P by Szent-Györgyi. It is a mixture of hesperidine and

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eriodictyol glycoside and belongs to the vegetable dyes of the flavine group. Its administration in a mixture called citrin was demonstrated to be effective in a number of pathologic conditions characterized by increased permeability of the capillary wall.

VITAMIN D is a sterol produced from ergosterol by the absorption of energy. Vitamin D itself seems to be the crystalline product which Webster and his coworkers called calciferol. Some workers contend that six or eight forms of vitamin D may exist. The exact mode of action of vitamin D is not known though in its absence the rate of calcium absorption from the intestine is diminished. Bile is as necessary for the proper absorption of this vitamin from the bowel as it appears to be for the absorption of the other fat soluble vitamins, A and the newly described vitamin K. Vitamin D is in all probability an enzyme and is one of the respiratory enzymes of the cell. Like these it may also play a role in activating or inactivating some of the hydrolytic enzymes. It is probably of use in the many tissues of the body that need to absorb and metabolize calcium phosphate. Possibly it acts in some way in conjunction with phosphatase. That it plays a part in respiration is indicated by the fact that in rickets the basal metabolic rate is below normal, and that the ingestation of vitamin D restores it to normal.

VITAMIN E.—This so-called antisterility vitamin is essential in those tissues where cellular proliferation and differentiation are particularly rapid. It therefore is indispensible in normal gestation. This postulation has been proven to be correct in rats and probably also applies to other species of animals. Its application in the human being still requires further elucidation.

Wheat-germ oil is the source of this vitamin. Recently Evans has isolated three distinct compounds from wheat-germ oil, one of which, identified as *alpha*-tocopherol, has been synthesized and has been shown to exhibit vitamin E activity equal to vitamin E obtained from natural sources.

VITAMIN K.—It has recently been demonstrated that a fat soluble substance present in a number of vegetables is essential in maintaining the normal prothrombin level of the blood. In prothrombin deficiency hemorrhagic tendencies promptly develop. Bile and bile salts are essential for the proper absorption of this substance. In experimental obstructive jaundice and in bile fistulae, in which bile salts were excluded from the gut, prothrombin fell to hemorrhagic levels. Clinically in man the administration of bile or bile salts to cases of obstructive jaundice has been effective in producing proper absorption of fat soluble vitamin K and consequent return to normal prothrombin levels with normal prothrombin clotting time and cessation of hemorrhages. The clinical value of this observation in preoperative treatment of obstructive jaundice is obvious.

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By the feeding of spoiled sweet clover to herbivorous animals liver damage has been produced and low prothrombin levels have been demonstrated, possibly due to the interference in the elaboration of bile acids and salts. Upon this observation it has been postulated that toxic hepatitis acts similarly to produce hemorrhagic tendencies in man.

Many more nutritive factors have been described and no doubt others will be discovered. Among those with less clinical application are—Vitamin T, a fat soluble substance from egg yolk and sesame oil, which seems to increase platelet counts in the blood; the gizzard erosion factor, concerned with hyperacidity and ulceration of the gizzard in chicks; the grass juice factor, which may be important in explaining the value of summer- over winter-produced milk; and others with at present less definite interest clinically.

SUMMARY.—At least seven vitamins have thus far been recognized and identified. Some have been isolated in pure form and synthesized. Other substances have been described as necessary and may be finally accepted as such. Probably there are others not yet discovered. Some of the vitamins have been found to be specific catalysts for certain respiratory or oxidative reactions of different cells of the body. It is probable that all of them are respiratory catalysts, though this has not yet been proven for some. Some act on the skin, the intestine, the central nervous system, at least one on the reproductive organs, others on the bones, the liver, the blood, and other tissues. Actually every cell of the body seems to need catalysts in the respiratory or oxidative reactions, which are the source of its synthetic powers. The cell must either make these catalysts itself, get them as hormones from other cells of the same body, or it must obtain them as vitamins from outside the body in food materials. Vitamins might be called exogenous hormones, in contrast with the endogenous or usual hormones.

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PHARMACOLOGICAL SHOCK THERAPY IN THE PSYCHOSES

WITH CASE REPORTS[1]

By Commander F. L. McDANIEL, Medical Corps, United States Navy, and Lt. Comdr. B. W. HOGAN, Medical Corps, United States Navy

The treatment of schizophrenia by hypoglycemic shock was introduced in the Vienna University Clinic for Psychiatry and Neurology in October 1933, by Dr. Manfred Sakel. In 1936, Dr. Sakel reported

[1] From the U. S. Naval Hospital, Washington, D. C.

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the results of his treatment of 104 cases.[2] These were divided in two groups, 58 of recent admission and 46 of older origin. In his report Dr. Sakel summarized his results as follows:

Fifty-eight new cases of whom 70.7 percent show full remission, with an additional 17.3 percent sufficiently recovered to return to work.

Forty-six old cases of whom 19.6 percent show full remission, with an additional 28.2 percent sufficiently recovered to return to work.

These amazing results, and similar ones reported from other European clinics, created much premature enthusiasm. The treatment was widely exploited in the press and the public were led to believe that a cure had been found for what had formerly been considered an incurable disease. The insulin shock treatment has been given to many hundreds of cases in the United States and at no clinic or hospital have these remarkable results been confirmed. The reports of insulin treatment for schizophrenia in different clinics show much disparity, although on the whole the rate of remission and improvement appears much superior to that obtained by any other method of treatment.

An idea of the results being obtained in this country may be had from table I from a paper read before the quarterly conference of the New York Department of Mental Hygiene, March 1938, by Dr. Benjamin Malzberg, who analyzed 1,039 cases of dementia praecox in the New York civil hospitals who received insulin treatment and 1,039 cases who did not receive this treatment.[3]

TABLE I*

(*a*) *Treated with insulin*

State hospitals			Recovered		Much improved		Improved		Unimproved		Still in hospital		Died	
Total		Total												
Males	Females		Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
525	514	1039	71	63	158	124	133	130	156	191			7	6
			12.9		*27.1*		*25.3*		*33.4*				*1.3*	

(*b*) *Treated without insulin*

525	514	1039	16	20	70	46	36	41	41	37	336	348	26	22
			3.5		*11.3*		*7.4*		*7.5*		*65.8*		*4.6*	

* Figures in italics indicate combined male and female treatment results by percentage distribution.

This paper also emphasizes that the rate of recovery and improvement was highest among those patients who had received the treatment early in the course of their mental disorder.

[2] Sakel, M.: Wien. klin. Wchnschr., 49: 1278–1282, October 16, 1936.

[3] Malzberg, B.: Psychiat. Q., 12: 3, 528–553, July 1938.

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The method of producing insulin shock varies somewhat in different clinics. The usual technique, which is the one in use at this hospital, consists in giving 10 or 15 units of insulin intramuscularly three times a day, 2 hours before meals, increasing the dose 5 or 10 units daily until a satisfactory shock or hypoglycemic stage is determined. The amount of insulin required for the shock dose is given at 7:30 a. m. No food is given until the noon hour. The patient is allowed to remain in coma for 1½ to 2 hours, and the treatment is terminated by nasal tube feeding of sugar water (1 gm of sugar to each unit of insulin) or by glucose administered intravenously.

Sakel, in his monograph on Pharmacologic Shock Therapy, states that the late epileptoid seizure occurring in the fourth or fifth hour of hypoglycemia is a danger signal and the hypoglycemia should be terminated immediately.[4] The early epileptoid seizure frequently occurring in the second and third hour of hypoglycemia he considers of therapeutic advantage.

Sakel also recommends terminating the treatment at definite stages, for example, he advises that in catatonic excitements to allow only a short coma, and that in the dull apathetic stupors it be terminated in the early restless and excited stage by intravenous glucose. He also advises the use of Metrazol superimposed on insulin in cases of emotional flattening and in insulin resistant cases.

The insulin shock therapy for schizophrenia was introduced at the United States Naval Hospital, Washington, D. C., in March 1937. At that time four actively psychotic patients were placed under this treatment.

In addition to the standard treatment we have had very gratifying results by giving 10 to 20 units of insulin three times a day, 2 hours before meals, for those border line mental cases with hypochondriachal complaints. After the injection of insulin, these patients are required to be moderately active physically and thereby producing a blood sugar state in the vicinity of the 45 to 55 mg-percent zone. This type of therapy has been found to produce noticeable improvement in the patient's mental and physical health.

A summary of our treated cases at the time of this writing follows:

Case I.—L. C. N., private, United States Marine Corps, admitted January 7, 1937 to the naval dispensary, Parris Island, S. C., with diagnosis **Dementia praecox, undetermined.** He had been in the Marine Corps about 6 months when he deserted. He submitted a statement basing his action on "divine and religious guidance." Prior to this for several months, he had become more secluse, devoting an unusual amount of time to religious matters, collecting religious books and pamphlets. He admitted auditory hallucinations, heard voices from Heaven during the night telling him to walk the straight and narrow path. At this hospital, he was found to be actively psychotic and in a moderately catatonic state. He was correctly oriented and with marked psychomotor retardation.

[4] Sakel, M.: J. Nerv. & Ment. Dis. 87: 140–155, February 1938.

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He spent his days holding his Bible and sitting by his bed. On March 19, 1937, insulin treatment was initiated. It was found that 45 units of regular insulin given at 7:30 a. m., on a fasting stomach was the amount necessary to produce a marked hypoglycemic shock state. He was given nine hypoglycemic shock treatments. Following the second treatment the patient was noticed reading a popular pictorial magazine and had written a long and intelligent letter to his mother. A month following the discontinuation of this treatment the patient was placed on the outside detail, was cheerful, worked well, became interested in other patients, showed normal affect, and was later given the privileges of visiting in the city. Psychiatric examination at that time revealed no evidence of psychotic mental content or abnormal behaviour. Patient was discharged to his home June 22, 1937, having made an excellent recovery. A letter received in September 1937, stated that he was at home with his mother, had a job, and was self-supporting.

Case II. R. D. J., corporal, United States Marine Corps, admitted from Parris Island, naval hospital, January 16, 1937. On admission his diagnosis was **Psychosis unclassified.** The history showed that he had deserted from a hospital September 22, 1936, while under treatment for a head injury. He had turned himself over to the police in Florida October 26, 1936. When first admitted to this hospital, he denied delusions or hallucinations, he was correctly oriented, but showed judgment defects, and claimed an amnesia from the time he deserted at Parris Island. He made a poor adjustment in the hospital during the first month, crying quite freely, felt that people were picking on him and expressed suicidal thoughts. A later psychiatric examination revealed the fact that he had been hallucinating for 3 years and entertaining delusions of persecution and ideas of reference, saying that people were hypnotizing him, casting spells over him, etc. He had obtained transfers from one post to another, in order to get away from these influences and it was apparent that he deserted from the naval hospital at Charleston, S. C., because these voices were getting too persistent and disagreeable. He had engaged in several fights when he felt that these disagreeable auditory hallucinations originated with some person in his environment. While here, he felt that certain patients had been trying to hypnotize him and had cast spells over him, thought they were talking about him, cursing and calling him derogatory names.

He was started on hypoglycemic shock treatments on March 19, 1937 and gradually worked up to 45 units of regular insulin administered at 7:30 in the morning and allowed to remain in a hypoglycemic shock state until noon. During this treatment he perspired freely, was irrational, excitable, carrying on a conversation with himself in French, tossing about the bed, striking his face, pulling the covers over his head, crying aloud, sobbing, and shouting. This episode was usually followed by a quiet stuporous condition. He received nine severe hypoglycemic shock treatments with gradual improvement following each and he was discharged to his home on August 13, 1937. At the time of his discharge, there was no evidence of any psychosis and no residuals from the previous illness. A letter received the first week in September 1937, stated that he was working as an apprentice carpenter for a construction company making a good weekly wage.

Case III.—J. W., EM. 2c., United States Navy, admitted to this hospital March 30, 1937 from the naval hospital, Philadelphia, Pa., with diagnosis **Paranoid state.** He had been admitted to that hospital February 23, 1937, for mental observation following an absence from his ship for a period of 10 days. He stated that he had been persecuted for being a Jew by the Nazis in the service. He was entertaining ideas of reference, and saw people who indicated by their actions they believed him to be a pervert. He also thought everyone was talking about him wherever he went. The past history showed that he had been admitted in

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1927 to the Pennsylvania Hospital for Nervous and Mental diseases, at which time he was hallucinated and delusional.

The family history revealed that his mother has been in a hospital for mental illnesses since 1913—diagnosis, **Dementia praecox, paranoid type.** Examinations here showed him to be entertaining unsystematized delusions. He showed an inadequate emotional affect with auditory hallucinations and ideas of reference. He had no insight, his judgment was defective, and he was mentally retarded. This patient was given 12 hypoglycemic shock treatments during which his delusional trend subsided and his insight increased. He was discharged to duty September 21, 1937, to evaluate the permanency of his recovery. There was no evidence of the previous mental illness. His general appearance, mental content, and behaviour were normal. He had made apparently a complete recovery. He stated he felt better mentally and physically than he had for a number of years. His insight was excellent, judgment was good. A stuttering condition which had been severe during his illness also showed a marked improvement.

Four months later this patient was readmitted on board his ship. He was psychotic with a paranoid trend and agitated. He was eventually transferred to St. Elizabeths Hospital for the insane.

Case IV.—V. R. F., F. 2c., United States Navy, admitted to this hospital from the New York naval hospital April 2, 1937, diagnosis, **Dementia praecox, paranoid type.** Aboard his ship he was placed under observation because of peculiar actions, extreme talkativeness, with ideas of persecution and grandiosity. At the New York naval hospital, he states, "I'm one of the best workers in the outfit. I get along with everybody, have a thousand friends, I don't have to ask the girls, they all want to go with me. I made $15,000 and lost every cent before I enlisted in the Navy. Owned a chain of bakeries. I graduated number 1 man in my class. All universities are offering me scholarships. I believe in faith in others, a four-square system, faith, love, truth, and honor. Be a man at all times, make your own future. I am going to study law, I can address the jury hour after hour. With faith in the faith of God you can't lose." He said his hospitalization was a frame-up to keep him from remaining in one place long enough to make a rating. He showed a flight of ideas, lack of insight, emotional disharmony, delusions of persecution, ideas of personal grandeur and a history of hallucinations, visual in type. Describing a vision, he stated, "One night on the ship, God sent Jesus Christ, to impress me with the force of right and religion, the vision appeared in a great beautiful halo of light, just the face of Christ. He didn't say a word just looked at me for a few minutes and I knew he was in my heart." At this hospital he showed the same mental picture, being euphoric with marked emotional swings. He spent his time constantly writing irrelevant and incoherent letters. This patient was given 12 hypoglycemic shock treatments, blood sugar level being maintained at 30 to 40 mg-percent during the hypoglycemic state. During and following treatment there was a marked decrease in his overactivity, grandiosity, and his silly behaviour.

He became quiet, well composed, performed all his details efficiently and his personal appearance improved. On September 1, 1937, the patient presented a normal picture physically and mentally with no residuals from his previous illness. He was returned to duty. Four months later he was readmitted to the sick list having had difficulty in readjusting to service life. He was discharged from the naval service although he could be classified as a much improved case.

Case V.—W. R. H., F. 1c., United States Navy, patient was admitted from the naval hospital, Great Lakes, Ill., with diagnosis **Dementia praecox** having been a deserter from his ship. At that hospital he was found to be hallucinating in the auditory fields, had no insight and his judgment was defective. At this hospital

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he was psychotic, confused, with mental retardation, exhibited auditory hallucinations and ideas of reference. This patient was given a modified insulin therapy producing hypoglycemic states ranging between 40 to 50 mg percent of sugar. Following 1 month of this treatment there was a marked improvement in his mental condition with disappearance of the agitation and restlessness and with noticeable increase in his working efficiency. He appeared happy, had good insight and was emotionally stable. He was allowed 25 days' leave and later discharged from active service as a recovered case.

Case VI.—P. H., HA. 2c., United States Navy, patient admitted from the Norfolk naval hospital July 15, 1937, diagnosis **Psychosis unclassified** with the history that he attempted suicide by taking an overdose of phenobarbital. His past history showed that from an early age he was a delinquent problem, hoboing, bumming, and drinking intoxicating liquors from the age of 14. He had made an unsatisfactory adjustment in the Navy, indulging in excessive amounts of alcohol.

Under moderate insulin doses, hypoglycemic states were produced three times daily with the lowering of the blood sugar to around 50 mg-percent. This treatment produced definite improvement in the general physical condition of this patient, increasing his weight and clearing his acne. Mentally he became free from tension, associated with other patients on a normal level. His sensorium cleared, his deportment was excellent and he seemed to be better stabilized. This patient was discharged to his home as a much improved case.

Case VII.—D. E. W., sergeant major, United States Marine Corps, admitted June 25, 1937, diagnosis **Psychoneurosis, unclassified**, presented a picture of anxiety, agitation, and hypochondriacal complaints. He lost weight and was unable to obtain over 3 hours' sleep at night without the use of a sedative. Moderate hypoglycemic states were produced in this patient, three times a day, following which he slept normally, appetite and weight increased and tension was markedly diminished. Anxiety and somatic complaints disappeared. Patient showed a definite improvement following insulin treatment, in contrast to other therapy, such as hydrotherapy and psychotherapy, used during the first 40 days following admission.

Case VIII.—P. J. H., CTM., Fleet Naval Reserve, admitted July 14, 1937. While a patient on the medical service he developed a psychotic episode. Psychiatric examination revealed a clouded sensorium with ideas of persecution. He stated that he had been given poisoned milk, that people were trying to steal his property, and that he had heard individuals plotting to injure him.

There was no insight and judgment was defective. The patient also complained of numbness and tingling in the hands and feet. Examination showed evidence of peripheral neuritis, extensive in the lower extremities with beginning bilateral foot drop. There was previous history of long indulgence in alcohol. He failed to show much improvement under general medical and hygiene measures and was placed on sufficient insulin three times a day to produce moderate hypoglycemic states. He was also given vitamin B and physiotherapy. The mental picture cleared considerably after 3 weeks of treatment, he was free of delusional content, and had good insight into his past difficulties. There was also a concurrent improvement in his general physical health with considerable improvement of the peripheral neuritis.

Case IX.—Lieutenant (junior grade), United States Navy, retired, originally admitted to the sick list August 1, 1931, at San Diego, Calif., under the diagnosis of **Psychoneurosis, psychasthenia**, at which time he was introverted and flattened emotionally, entertaining ideas of self destruction and exhibited suicidal tendencies. He was hospitalized for a total period of about 20 months.

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He adjusted satisfactorily after discharge but remaining socially aloof from his friends.

He was admitted here in February 1937, displaying a clinical picture very suggestive of schizophrenia. There was inadequate emotional response, conversation was limited, revolving around his past problems, and his subjective symptoms. He was given 67 days of hypoglycemic treatment. The clinical picture improved following this treatment, in that his tension was markedly decreased, his outside interest returned, and he was discharged socially recovered.

Case X.—A senior officer displaying the clinical picture of **Psychoneurosis** occurring in the evolutional period was given modified insulin therapy for 20 days without change in his clinical picture. Records of other clinics indicate that this type of patient should be treated with Metrazol.

Case XI.—Lieutenant (junior grade), United States Navy. Retired 1928; diagnosed **Dementia praecox**. This patient had spent considerable time in mental institutions since his retirement. At no time was he in satisfactory mental health. He was admitted in an acutely psychotic state, appearance disheveled, and his pockets filled with debris. His speech was rambling and irrelevant and he was antagonistic and belligerent.

Patient received 15 hypoglycemic shock treatments and showed a marked lowering of tension and restlessness. He became correctly oriented, resumed a normal interest in his affairs, maintained a well-groomed appearance, and was discharged at his own request as a much improved case.

These cases seem to demonstrate the efficiency of insulin treatment over other forms of therapy. All cases reported, except one, were benefited. Two of the apparently recovered cases had relapses after return to duty, one mild, the other a more serious relapse. We believe an important element in the treatment of these cases to be the normal atmosphere or environment that is present in our naval hospitals as compared to the existence in a strictly mental institution. This point should be stressed as an argument in favor of treating our mental cases as far as possible in our naval hospitals.

No attempt has been made to select our cases for insulin therapy. Sakel and others have held that the chances for cure or improvement were better in patients in whom the disease was of fairly short duration. In a recent paper, Bolles, Rosen, and Landis [5] report the result of studies carried out at the New York Psychiatric Institute, using psychological performance tests as a basis for detecting those patients most likely to respond to the hypoglycemic shock therapy. These authors, working with a series of only 19 patients, have found that schizophrenics regardless of the duration of their disease, who show responses approaching normal in performing tests requiring abstract thinking, are the patients who respond most readily to insulin therapy.

Metrazol

In the year 1934 Professor von Meduna, working at the Royal Hungarian State Mental Hospital, advocated the treatment of schizophrenia by inducing an epileptic seizure in the ill person. He based his idea primarily on the work of Nyiro and Jablonszky, who in 1921 published a paper on epilepsy, in which they stated, "that in those

[5] M. Marjorie Bolles, Ph. D.; G. P. Rosen, M. A.; C. Landis, Ph. D. Psychiat. Quart. 12: 733–737, 1938.

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epileptics who developed schizophrenia, the epileptic attacks gradually diminished in frequency and finally disappeared altogether." Von Meduna also quotes Steiner and Strauss, who found only 20 cases of convulsions (of all types) in over 6,000 schizophrenics. He felt that epilepsy and schizophrenia were antagonists.

Dr. von Meduna first used a 25 percent camphor in oil solution injected intramuscularly, but because of the local complications such as abscesses, inflammatory reactions, etc., and also its unreliability, he changed to Metrazol. He injected this drug intravenously and secured immediate epileptiform seizures. He found this drug to be more consistent in its action, more rapid in its results, and fairly free from injurious complications.

Metrazol, known as Cardiazol in Europe, is the proprietary name for a synthetic drug. Chemically it is pentamethylenetetrazol. Pharmalogically it belongs to that class of substances known as analeptics, which stimulate the vasomotor and respiratory centers in states of depression. In large doses it produces neuromuscular hyperirratibility and convulsions.

In 1935 von Meduna published his first article on the convulsive therapy of schizophrenia. In this article he promulgated his theory of the antagonism between schizophrenia and epilepsy and presented 26 cases, 10 of which showed complete remission following treatment by induced convulsive attacks. He now states that in cases up to 6 months in duration, there is an 80 to 90 percent probability of remission. In the sixth to twelfth month duration class, the rate dropped to 45 percent, and in the chronic cases of 4 years or longer, no remission is to be expected.[6]

Technique of the Treatment

The contradictions are few. In patients with arterial hypertension, advanced cardiovascular disease, renal disease, febrile states, and general debility this treatment is to be avoided. Many elderly depressed patients have been subjected to the treatment without serious accident.

The Metrazol is injected intravenously at a rapid rate. The usual initial dose in this country is 3 cc of a 10 percent solution. This is increased 1 cc daily until the convulsant dose is reached, which is generally 6 or 7 cc.

The convulsion appears immediately following the injection of Metrazol and lasts 30 to 120 seconds. It partakes of the nature of a severe grand mal epileptic seizure. The total duration of the treatment from the time of the injection until recovery of consciousness is usually 5 to 10 minutes.

[6] von Meduna, L.: Psychiat.-neurol. Wchnschr., 39: 331-334, July 24, 1937.

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In contrast to insulin therapy all the apparatus necessary is a 10 cc syringe and needle, the solution, and a well-padded tongue depressor.

The usual course of treatment consists of a series of convulsions being given twice weekly until improvement occurs or until about 20 convulsions have been induced. Many cases show complete remission after the third or fourth convulsion.

Up until July 1936, 1,000 attacks had been induced without any serious complications. Dislocations of arms, shoulder and jaw have been reported in exceptionally violent convulsive seizures.

The results of the two methods, insulin hypoglycemia and Metrazol convulsive attacks, if we can believe the statistics available are approximately the same.

The most extraordinary results have recently been reported by Bennett of Omaha, Nebr., in the treatment of depressive psychotic states. He treated 10 depressed patients with Metrazol, inducing epileptic-like seizures. Four of these cases were severe involutional melancholia types and the remainder were manic depressive psychotics, depressed type. All of these patients appeared to be completely relieved of the depressive features of the psychosis within 2 weeks after treatment was started. He reports no complications from the treatment in any of these patients, yet three were past 60 years of age and one past 57 years.[7]

Doctor Bennett has since treated 25 cases with improvement in each instance.

It is difficult to obtain a fair evaluation of insulin or Metrazol therapy due to the peculiar course of schizophrenia, its tendency to spontaneous remission without apparent cause, and the variety of therapeutic measures to which it may react. For this reason many psychiatrists continue to be skeptical in spite of excellent results reported by so many investigators. Greater optimism, however, regarding shock therapy in schizophrenia might prevail, if a more conservative point of view were maintained, namely, that through insulin and Metrazol, eventual remissions have been accelerated and perhaps are more extensive and of better quality. Viewing the successes of these methods of treatment one gains the definite impression that their value lies in preventing a long period of incapacity and the fixation of the psychotic process.

Summary

1. A short outline of the hypoglycemic insulin shock treatment and Metrazol convulsive therapy in schizophrenia is presented.

2. Eleven cases treated by insulin shock are reported. Seven psychotic cases made recoveries, however, two of these had recurrences. Three chronic cases were greatly improved.

[7] Bennett, A.: Am. J. Med. Sc., 196: 420-428, September, 1938.

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3. Bennett reports amazing results obtained in 10 cases of depressed psychotics, involutional, and manic depressive states, with Metrazol therapy.

Conclusion

1. Insulin hypoglycemic shock therapy and Metrazol convulsive therapy are valuable and available methods of treatment.
2. This therapy is especially applicable for the Navy's mentally ill cases who are generally hospitalized in the first few weeks following the onset of their illness.
3. If Metrazol therapy bears out the claims of von Meduna and the American enthusiasts it will prove to be ideal therapy for the Navy's use, because of its simplicity and economy.
4. It is believed that the use of these therapeutic methods will render many patients fit for discharge from the Navy and able to return to civilian occupations.
5. The long period of hospitalization and institutional care that is now our problem will be measurably shortened.
6. These treatments can safely be given in our naval hospitals.

CHRONIC ARTHRITIS [1]

By Commander Earl Richison, Medical Corps, United States Navy

Arthritis has existed for ages, as shown in the fossil remains of animals. Certain of these remains show undoubted bony lesions which were the result of arthritic manifestation. Although this entity has existed for such a long period of time and its economic aspect is of the greatest importance, it is only recently that definite steps have been taken toward a fuller understanding of the disease and of its treatment.

It must be stressed that the disease is a generalized disease with joint manifestations. It may be of metabolic or infectious origin. Some of the etiological factors are:

(*a*) *Heredity.*—The history of an arthritic patient frequently reveals the presence of arthritis in others of the family.

(*b*) *Fatigue.*—Both physical and mental fatigue seem to play a part in the onset of symptoms of this disease, as patients will frequently date the onset of their symptoms following some severe mental or physical strain.

(*c*) *Exposure.*—In his studies in the case of a large number of soldiers during the World War, Pemberton showed that exposure was a large factor in bringing on the symptoms of the disease.[2]

[1] This brief summary is based upon a series of lectures delivered by Ralph Pemberton, M. A., M. D., F. A. C. P., professor of medicine in the Graduate School of Medicine, University of Pennsylvania, delivered at the Abington Hospital, Abington, Pa.

[2] Pemberton, R.: Arthritis and Rheumatoid Conditions, their Nature and Treatment. 2d ed., 1935. Lea and Febiger, Philadelphia.

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(*d*) *Infections.*—Foci such as tonsillitis, infected foci at the root of the teeth, sinusitis, prostatitis, mastoiditis, appendicitis, infections of the gall bladder, have been stressed; and a number of these cases do improve in a remarkably short time after removal of the foci of infection.

(*e*) *Race.*—The Hebrew race, owing to racial characteristics, are frequently victims of arthritis.

(*f*) *Sex.*—More females are affected than males.

(*g*) *Age.*—Menopause seems to increase the incidence of the disease. At about the time of the climacteric a number begin to show symptoms of hypertropic arthritis. The sudden change in the endocrine system, and the tendency of the majority of the female sex to an increase in weight at about this time of life may have a bearing upon the development of the disease.

(*h*) *Faulty metabolism.*—Pemberton has shown by a series of experiments that the sugar metabolism of the arthritic may be faulty, in that ingested sugar may not be removed sufficiently rapidly from the blood. This is not due to a diabetic disorder or to inability to combust sugar. It is probably referable to partial interference with the circulation in that the blood does not adequately reach certain tissues such as the muscles. Cases that manifested disturbed sugar metabolism and benefited by treatment, regained normal or nearly normal sugar tolerance.

(*i*) *Posture.*—Faulty body posture probably has some bearing upon the production of the disease.

(*j*) *Disturbed body chemistry.*—This disturbance may be due to the chemical reaction of the organisms within the body, but the disease is not a disease characterized by organisms within the blood stream or within the joints. It is only very seldom that streptococci can be demonstrated within the joint of the arthritic.

The two great subdivisions of this disease are atrophic arthritis, or rheumatoid arthritis, and hypertrophic arthritis or osteo-arthritis.

ATROPIC ARTHRITIS is a disease of the first half of the life span. The general physical build of the patient is frequently not normal. The blood usually shows a low hemoglobin content. Foci of infection are usually present. The affected joints show rarefication of the bones concerned. The joints involved are not constant, the condition being a migratory, polyarthritic one. The affected joints by x-ray show narrowing and cloudiness of the joint space which terminates in deformity and ankylosis.

HYPERTROPHIC ARTHRITIS is a disease of the later half of life. The patient is usually heavy or obese. The blood shows a normal hemoglobin content. Foci of infection are usually absent. There is a condensation of the articular margins, chiefly of the knees and fingers. The condition is frequently localized. There is a lipping of the bony

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margin of the joint, with cyst formation in the bones concerned. Heberden's nodes frequently form at the joint margins. There is usually no ankylosis of these joints.

Arthritis being a systemic disease may show many forms of gross morbid anatomy and symptoms. There may be myositis, neuritis, headache, so-called neurasthenia, mental lebetude, psychosis, iritis, liver and kidney damage, and many other manifestations as well as the bony changes which appear later in the progress of the disease. These bony changes have been likened to the charred remains of a burned house; they show that there has been a fire. In ordinary cases there are no evidences of bacterial invasion within the joint spaces. Physiology shows that at points where bony tissue is being produced there is a slowing or retarding of the body fluids. Calcification may take place within an infarct or other places within the body where the blood supply has been cut off. Also calcification takes place more readily in an alkaline medium. Osteoblasts, the parathyroids and vitamine D, all have a bearing upon osteogenesis.

In atrophic arthritis a pannus formation over the joint cartilage takes place. This pannus smothers the cartilage of the affected joint thus aiding in destroying it. At the same time the endosteum of the bone throws out trabeculae which penetrate and destroy the cartilage of the joint. Thus bone comes into contact with bone. Fibrous union takes place which may later be replaced by bony union, thus producing ankylosis and atrophy of the bone and joint occurs.

In hypertrophic arthritis there is a degeneration and fibrillation of the cartilage, thus in spots within the joint, bone comes into contact with bone and eburnation results. Cysts form in the end areas of these bones causing softening, and near an area of eburnation the bone may become so soft that "mushrooming" of the bone may occur with resultant "lipping" as shown in the x-ray. There may be an hypertrophy at the joint margins forming Heberden's nodes. In the atrophic arthritic the joints should be frequently moved by the patient himself, cautiously in the acute stages, in order to prevent ankylosis. In the hypertrophic, exercise is not so important, although motion must be maintained. Rest is more important in hypertrophic arthritis since some observers believe weight and trauma constitute chief etiological factors. Rest can be modified freely in this type, however, because ankylosis almost never supervenes.

In arthritics the basal metabolism rate is usually below normal. This does not mean that they have hypothroidism or myxoedema. Arthritics show no disturbance of protein metabolism; therefore, they should be allowed red meats. Uric-acid metabolism is not essentially disturbed, fruits may be allowed with impunity. There may be a localized acidosis at the diseased joint but the layman's idea of an "acid system" is, of course, a fallacy. In arthritics there is some

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disturbance of the creatinine metabolism but the blood chemistry as a whole is essentially normal. The calcium and phosphorus content of the blood is normal. Fat and cholesterol are usually normal. There is a slight lag in the excretion of salts and water by the kidney and a tendency to retain fluid develops. The sedimentation rate is increased in a great many cases, this being more marked in the atrophic than in the hypertrophic. Although the glucose tolerance curve frequently shows an abrupt rise and an abrupt early fall in arthritics, this curve may rapidly approach the normal after the removal of foci of infection. Although the glucose tolerance curve is disturbed, oxidation of sugar takes place in a normal manner.

In arthritics there seems to be some disturbance which hinders the blood from reaching the peripheral circulation. The muscles of these patients do not receive an adequate supply of blood. In a normal person the first blood following skin puncture contains more red blood cells than the later flow, in arthritics there is a lower red blood cell count from the arterioles in the first flow than from the later flow. Arthritics have a slower peripheral circulation, under normal conditions, than the normal person. Placed in a cold room the peripheral temperature of the arthritic does not drop as much as the normal, nor does it respond as rapidly as does the normal peripheral circulation upon being brought again into a warm atmosphere. The capillary field of the arthritic is or at least appears to be definitely less than the capillary field of a normal individual.

As arthritis is a system disease, the endocrine system may be involved. The pituitary gland regulates skeletal growth and sugar metabolism. The post-pituitary body is associated with water metabolism and vasomotor regulation of the capillaries but it is doubted that the pituitary is directly concerned in arthritis. The thyroid gland may be implicated in arthritis but definite proof has not yet been advanced. The parathyroids may be implicated in the demineralization of the bone in arthritics. The pancreas, the medulla and cortex of the adrenals are not concerned in the production of arthritis. The gonads may be implicated in that atrophic arthritis occurs in the first half of the life span and hypertrophic in the last half.

As the joint cartilages have no blood vessels, they are furnished food by and from the synovial fluid. The synovial fluid leaves the joints by the blood stream and by way of the lymphatics, this removal is stimulated by massage and by passive motion. In hypertrophic arthritis, the central portion of the cartilage degenerates, the marginal cartilage is stimulated, and forms lipping and Heberden's nodes. A deficiency of vitamine c may produce proliferation of synovial membrane and finally fibrous and bony ankylosis. By a carefully controlled series of experiments Pemberton has shown that by curtailing

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the blood supply to the patella of dogs, a definite hypertrophy of the patella occurred in each case.[2]

The arthritic of the atrophic type is usually of the asthenic build, with a long narrow chest, inclined to have lordosis and the vertebrae are of a distinct type as shown by x-ray. The intestines may be distended and enteroptosis may be present. The sacculation of the colon may disappear when avitaminosis is present. The intestines may lose tone, become enlarged and more or less stasis occurs. These patients are of the so-called tubercular type. They are in a manner handicapped at birth by their hereditary tendency to this particular body type.

The patient having atrophic arthritis usually presents the joint symptoms first in the proximal phalangeal joints of the hands. There is atrophy of the interosseous muscles and weakness of the extensor muscles. Thus, the hand becomes deformed even if ankylosis of the affected joints does not follow. In the hypertrophic cases the distal joints of the fingers are usually affected first and joint mice and Heberden's nodes are formed. The hands are cold and clammy. This may be due to the disturbed peripheral capillary circulation. There may or may not be noticeable swelling and edema of the affected joints.

In order to reduce the swelling of the parts, the optimal water balance in the body should be maintained. Some of the swelling in arthritis is probably due to what may be called a low-grade oedema of the tissues. This can sometimes be controlled, in part at least, with benefit to the patient by one or more of several measures. Complete rest in the recumbent posture promotes passage of tissue fluids into the vessels. Purgation and sweating are useful if employed in moderation. Massage promotes a diuresis when properly carried out. And finally, intelligent use of dietetics. Without any injustice to the patient's nutritive needs the diet can be so arranged as to be slightly dehydrating and may be made up approximately as follows: 1 gram protein per kilogram of body weight, carbohydrates, 25 to 35 percent of the necessary calories, and fats approximately 60 percent. Very attractive and adequate diets can be prepared with the above determined values. At times it may be necessary to concentrate upon foods containing sulphur.

Patients having arthritis must be studied from all angles and efforts made to alleviate disfunction. The stoop-shouldered, pot-bellied individual should correct his postural condition; food or vitamin deficiencies should be studied. Efforts toward attempting to correct, if possible, faulty functions of the different systems, as discovered, should be attempted. Foci of infection as a rule should be removed but not hurriedly. The time, place, and conditions of removal must be arranged. The patient should be brought into the best possible physical

[2] See footnote p. 61.

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condition before foci of infection are removed, otherwise the arthritic process may be stirred to greater activity. Once the patient has ankylosed joints the prognosis for improvement is worse. Postural treatment to correct deformaties must be undertaken, massage and exercise should be used but not to the point of fatigue. Physical relaxation and relief from mental worries are important. Patients must be instructed, especially those having atrophic arthritis, that they must use the affected joints; in doing this the patient will not overexercise, due to the pain. Correction of postural deformities should be undertaken very gradually. With patience and cooperation of the patient a great deal can be accomplished for the benefit of the arthritic. The point to be borne in mind is that the joint manifestations are a late symptom of a generalized disease, which has progressed far beyond the initial stage.

Physical therapy, the age-old method of combating disease, can and should be used in the case of the arthritic. It may be employed as massage, as heat and cold, as exercise, or as electrical stimuli. Experiments and research have shown that there is usually an increase in the volume of urine, and that there is an increase in the hemoglobin of the blood stream, following massage. Massage in general produces little if any change in body metabolism, but it is believed to cause a definite increase in the red blood cells, this probably accounting for the increased hemoglobin content. Massage as well as other forms of physical therapy may be of great harm to the arthritic if improperly used. The affected joints in general should never be massaged. Gentle massage may be and should be used on the atrophied muscles near the joints. This gentle massage may be increased and made more vigorous as the case warrants, but each case must be treated as a case unto itself.

Application of heat gives an increased oxygen content in the venous blood, probably due to the increased circulatory rate. Experiments have shown the enormous influence heat and cold have upon the capillary circulation. Moving pictures illustrating these points have been made and there is a tremendous increase in the rate of flow following the application of heat. There is a comparable slowing or stasis of the flow following the application of cold. Also the application of heat causes a tendency toward a relative alkalosis.

Exercise causes a decrease in the plasma carbon dioxide combining power and a relative acidosis. Of course, exercise in the arthritic must be limited to the individual case; and, as with all other physical therapeutic agencies, it must be used in the proper amount, at the proper time, and in the proper place.

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GONORRHEA TODAY[1]

By Commander Robert P. Parsons, Medical Corps, United States Navy

Some definite trends in various phases of the general problem of gonorrhea have become quite obvious to interested observers since 1930. Some of these trends have been more striking during the past 2 or 3 years, but the indications are that most of these changes actually had their beginnings at about the start of the present decade.

These changes are in the nature of a renaissance. After all these hundreds of years of the dark ages, society has rather suddenly come to some realization of the extent of gonorrhea and has found out something of its cost in the economic sphere and its capacity for trouble-making in many ways other than its well-known production of physical suffering. This social awakening and new popular view of the subject has resulted in, or at least has been accompanied by, a great stimulation of scientific interest within the medical profession, with the very natural result of distinct reduction in prevalence rates, better sanitary control of infective sources, better prophylaxis methods, better diagnosis, vastly better—even though simpler—methods of treatment, and a more sane, humane, and decent attitude on the part of the doctor and the hospital toward the gonorrhea patient.

This optimism is based on relative rather than absolute values. To use the language of Hollywood, we have succeeded in reducing a super-colossal problem to one that is now merely colossal and which gives promise of being further reduced in a few years to the class of just plain big.

Many of my conclusions are taken from Navy Medical Department data and naval experience. The gonococcus is no discriminator, and all conditions with respect to gonorrhea in the Navy are such that observations in the Navy are applicable to conditions anywhere. Because of rigid requirements as to reporting of new cases, complications, sick days, etc., the Navy (or Army) figures come closer to the truth of the matter of gonorrhea than figures anywhere for the same age and sex group.

Over a period of many years gonorrhea occupied first place among diseases of the Navy both in point of new cases per year and in point of sick days, but since 1925 it has been outranked by catarrhal fever in number of admissions, although still holding first place in sick days, with a total of about 100,000 sick days per year.

Prior to 1930 there was very little fluctuation in the annual rate, this varying from 70 to 85 new cases per 1,000 men per year, but since 1931 there has been a precipitate and steady drop of the curve, reaching new low levels of 51, for 1935, and 43.8 for 1936. This is only

[1] Read at the annual meeting of the Hawaii Territorial Medical Association, Honolulu, Hawaii, May 20, 1938.

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about one-half of the level of former decades.[2] The 1937 figures approximate those for 1936. These figures are scarcely comparable to the estimate arrived at by public health surveys for the general population of the United States, which has been placed at 8 per 1,000 population (1 million new cases per year), except to indicate a probable close similarity of prevalence for a similar age and sex group among the United States population.

This decline of incidence has, I think, been the result of a combination of factors, among which should be mentioned:

(a) Education as to the undesirability of acquiring gonorrhea.
(b) Increasingly popular and more readily available athletic sports and other healthful forms of recreation.
(c) Increasing marriage, or at any rate, less promiscuity in domestic relations.
(d) Improved methods of prophylaxis.

I have no figures to offer in proof of the real existence of any of these factors or of their relative importance, but I have been impressed from the observation of their trends for many years. For example, our rates have always been from two to four times as high in the Asiatic fleet as in the rest of the Navy, and the salient differences of conditions on the Asiatic station are those of comparative absence of traditional American forms of recreation, absence of the domestic ties at the home ports, and the extremely ready availability of infective sources.

So far as the Navy is concerned, the largest factor has been the slow realization of the feeble worth of chemical prophylaxis, with its tardy and haphazard application, and now its wide substitution by rubber prophylaxis which is practically 100 percent effective and which has been encouraged in every way in the Navy during recent years. The chemical methods are still in use but have long been regarded as little more than a superfluous ritual, something like the use of the finger bowl at the conclusion of a dinner.

It seems very reasonable to suppose that one very potent factor in the remarkable reduction of the gonorrhea rate in the Navy is that there has been a drop in the civilian rate and that the 50 percent reduction in the Navy rate may indeed be due in large part to the greater scarcity of infective sources in the civilian world. Whether this conclusion is true or not, the fact remains that some set of forces, very probably the ones we have mentioned, have been operating to bring about the greatest decline in venereal rates in the history of the Navy, and the same forces can be made to operate in any other population that has sufficient desire for them.

To present further evidence of how social conditions may affect venereal rates, I should like to cite two extremes. In 1920 the ship of which I was a medical officer, with about 1,000 men on board,

[2] The rates were also low in 1917 and 1918, the war years, when conditions were abnormal.

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spent much of its time in Russian and Italian ports, where the towns were wide open and the principal forms of diversion to be had ashore were liquor and sex. Our venereal rate was more than 1,000 new cases per 1,000 men per year, and based on an annual rate, we established the all-time Navy record of 1,600 during 1 month that we were in Naples. Those were the days when the greatest stress was placed on and hope placed in the practice of chemical prophylaxis. The other extreme is for the year 1936 in the Territory of Hawaii when our naval population of 2,831 men showed an annual venereal rate of only 30.7, in contrast to the rate of the Navy at large, which was 65.5 for the same year.

Diagnosis

Certain noteworthy advances have been made in the field of diagnosis since 1930. Since the introduction of McLeod's [3] cultural method in 1934 this technique has come into increasing use at hospitals, clinics, and health centers in the United States because it effects a positive diagnosis in about twice the number of adult females that could be obtained by smear methods. Although it shows no great superiority over smear methods of diagnosis in the male it does furnish valuable additional evidence in tests for cure in the male.

Research in complement fixation methods has been greatly stimulated since Price's [4] publication in 1933 but to date the best the laboratories can offer are methods which give about 15 percent false positives and 15 to 30 percent false negatives. We may hope that in due time, with additional refinements and improvements, we shall have complement fixation tests of great practical value in the determination of such questions as pelvic gonorrhea in the female, gonorrheal arthritis in the male, and tests for cure in either sex. That the subject has awakened wide international interest is evidenced by the fact that there is to be held at Copenhagen this summer an international conference on the serology of gonococcal infections. This present-day status of diagnosis is a far cry from that of former decades. It used to be a very common, but now a very rare, experience of mine to see patients admitted to the hospital with an erroneous diagnosis of gonorrheal urethritis because the original doctor had neglected to make a smear, or had been unable to read a smear correctly or, at times, had even failed to retract the prepuce to note that the exudate was coming from a chancre or some other lesion of the glans or the mucous surface of the prepuce.

Treatment

It has often been stated that scarcely any branch of therapy has remained so stagnant as the treatment of gonorrhea. Few diseases

[3] McLeod, J. W., Coates, J. C., Happold, F. C., Priestly, D. P., and Wheatley, B.: Jour. Path. and Bact., 34: 221, 1934.

[4] Price, I. N. O.: London County Council, London, 1933.

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have had so many remedies offered for their cure with so much enthusiasm and promise and yet with such dismal disappointments in the results. But I think it can be said with much reason and truth that the past decade has seen an encouragingly large volume of good, solid, honest, scientific hard work in this field and that the work has already borne some good results.

Books and teachings as late as 15 years ago gave us some very elaborate instructions about a confusing variety of drugs and instrumental procedures. But this decade has brought us the teachings of a new school, the chief proponent of which is Pelouze. This school has redistributed the emphasis on the different thereaputic angles so that nature and tissue immunity processes have more of a chance. The new keynote is conservatism and simplicity, with the virtual discard of all instruments except the syringe and irrigator and finger cot, and the rigid forbiddance of alcohol and sex excitation.

While there are numerous exceptions to all rules in gonorrhea, this new conservatism has in the main resulted very definitely in earlier recoveries and fewer complications.

We have never found any improvements for injecting and irrigating materials over our old organic silver salts and potassium permanganate. While here again there are the many cases in which either no benefit or positive harm comes from the use of these drugs, anyone can see that in nearly all of the early cases they have a very favorable influence on the course of the disease providing they are not used too strong or too often or too forcibly.

If the discharge persists after the second month and there are shreds and pus in the second glass the chances are about 100 to 1 that the chief source of the discharge will be found to be the prostate, and about 20 to 1 that a series of gentle prostatic massages and permanganate irrigations will hasten the day of a dry urethra, clear urine, and a happy patient. This is a simple truth but apparently it usually takes years to learn it, if learned at all. The reason for our mental sluggishness in this matter is possibly our strong distaste for and consequent lack of interest in the subject of things gonorrheal, or possibly because the more we realize this truth the more work we make for ourselves. If there is anything more arduous and monotonous and disagreeable in all of medicine than massaging 50 prostates in a day, I don't know what it could be. Yet, if one has a good missionary spirit, there is probably no better way of gratifying his craving to help his fellow men or any way so profitable to the fellow men if they are gonorrheal males beyond the sixth week of urethral discharge.

While gonorrheal arthritis complicates only about 1 case in 50, each case of it makes about 50 times the impression on both doctor and patient. In naval experience these cases have been costing

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about 60 sick days each, but two forms of treatment which have come into use during the present decade appear to offer great promise in a remarkable reduction of sick days and in removing the features of this complication which formerly made us view it with such dread. The new treatments referred to are artificial fever and sulfanilamide.

The great trouble with fever therapy in its present state of development is that when the fever is carried high enough to give a fair certainty of cure it may get out of bounds and out of control. This therapy utilizes a procedure that has mortality possibilities for a disease which in itself has no mortality. Of course the newer refinements in technique lead us to hope that this will eventually become a safe and very helpful form of therapy for such heretofore worrisome complications as arthritis, prostate and vesicle infections, and female pelvic infections.

As for sulfanilamide, our experience has been quite limited with arthritis, but we have come to expect one of two things with this drug in arthritis as in other gonorrheal disorders—either a miraculous cure in a very few days or that the course of the disease will remain entirely uninfluenced. The proportion of arthritis cases showing remarkable benefit from sulfanilamide seems to be about 50 percent, but our own series and other reported series are so small that present conclusions on this point may be quite erroneous.

This brings me to some general remarks on the subject of sulfanilamide. We are still making some rough guesses on percentage expectancies on early uncomplicated cases although our case collections are now quite large. We look for good cures in the first week in about one-tenth of the cases and during the first month in about one-fourth of them. If they do not get well in the first month then it appears that sulfanilamide had no beneficial effect except that some observers are convinced that even in the cases where there is no apparent shortening of the disease, there is a notable reduction in the percentage of complications. Different results with sulfanilamide in different hands are no doubt due to other factors in case management. Our routine therapy has been to put our patients to bed the first week, restrict them to the hospital grounds, for a month if necessary, in order to keep them away from sex, alcohol, and strenuous physical exertion, and to give them 80 grains of sulfanilamide a day the first 2 days and 60 grains a day the next 12 days. If discharge is present after the second week our routine then is to discontinue the sulfanilamide, give them 1 week of daily argyrol injections, and daily permanganate irrigations thereafter.

It is difficult to say in terms of figures just how much of an advance we have gained by sulfanilamide. But I think it is reasonable to say that without it we were lucky to have 1 case in 100 get well in the first week or 1 case in 20 get well in the first month, the usual course being

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about 40 days to obtain a dry urethra and clear urines. If these estimates are correct, the average course of the disease in the male has been shortened at least 25 percent by this new therapy.

Whether sulfanilamide reduces the percentage of complications, and if so, how much, are questions which cannot be answered with certainty this early. They are questions which should be answered with nice accuracy in another year because the epididymitis rate is the least variable of all things about gonorrhea. In untreated cases the rate remains constantly at about 10 percent. Rates below that figure indicate either good treatment or concealed cases of epididymitis and rates much above it indicate either bad treatment or concealment of gonorrhea. That is, if there are 100 known and properly treated cases of male gonorrhea in a certain population and these include 20 cases of epididymitis, the conclusion is that there are about 100 other cases of gonorrhea concealed in that population.

In the Navy the rate had remained around 10 percent for years but since 1930 it has been rising and has increased every year from 11 in 1930 to 16 in 1936. Since the extent of concealment in the Navy is a negligible quantity, the only explanation I can offer for such an excessive epididymitis rate is that of bad treatment or bad management. My guess would be that the treatment has been increasingly conscientious and thorough and hence increasingly bad. The gonococous filtrate and other vaccines were quite popular in the Navy in 1935 and 1936, and very possibly they were guilty parties in those years since they have been openly accused in various civilian centers. Sulfanilamide descended on the Navy early in 1937 and if the statistics for that year should show an epididymitis figure much below 10 percent I think that sulfanilamide will have gained a regular place in our therapy until displaced by something better.

With the volume of research work now being done in several countries, especially England, we may indeed anticipate something much better and possibly soon. To quote Surgeon General Parran,[5] "One of the most intriguing characteristics of medical research work lies in the possibility that overnight a remedy of unbelievable therapeutic potency may be produced, and that the millenium of gonorrhea control may be close at hand."

The most intangible and yet one of the really very important advances in gonorrhea is our newer attitude toward the patient and the disease. Better human understanding gives us more compassion and wins greater confidence and cooperation from the patient. We have almost reached the point where patients believe us when we have occasion to tell them that the very best treatment is to forget about treatment. Early gonorrhea and prostatic complications can

[5] Parran, T.: Transactions of the American Neisserian Medical Society, 1937.

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produce great mental suffering and worry, even to the point of suicide. It is in this phase that the wise doctor can accomplish miracles with the proper psychological approach.

Greater dignity and decency and professional stimulation are coming from the changed surroundings and atmosphere of treatment rooms. The old policy was that anything was too good for such a business. Hospitals assigned the poorest space and the most incompetent personnel to the gonorrhea service. In private practice a large share of the patients were being treated by charlatans or through the advice (and sales) of drug-store clerks. The present tendency is to have the rooms and equipment and bed space as elegant as any other part of the hospital and staffed with personnel that measures up at least on a par with the rest of the hospital staff. A physician may now treat gonorrhea in a private office, intelligently, honestly, and respectably and without losing his professional standing among his colleagues.

A great deal of the progress in America in the direction of this new attitude toward gonorrhea, it seems to me, has been fostered and furthered by the zeal and spirit of the American Neisserian Society, now in its third year and continuing steadfastly in its high mission.

SULFANILAMIDE AND CHEMOTHERAPY

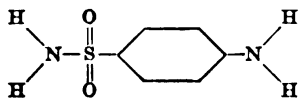
A SUPPLEMENTARY REPORT

By Lt. Robert A. Bell, Medical Corps, United States Navy

A previous report emphasized the confusion concerning indications, mode of action, and therapeutic application of sulfanilamide (1). With the accumulation of experimental and clinical experience such factors are being clarified. This paper endeavors to correlate these results and presents an analysis of 44 additional cases of gonoccoccus infection in the male. The laborious research culminating in clinical usage has been reviewed (119).

Chemistry

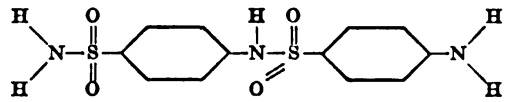
The original drug in this series was Prontosil, formed by the addition of the sulphonamide group to the molecule of the azo dye chrysoidine (2). Its therapeutic activity lies in a reduction derivative *para*-amino-benzene sulfonamide (3) (190), termed sulfanilamide (4), and Prontosil itself has negligible activity *in vitro*. Sulfanilamide with the formula



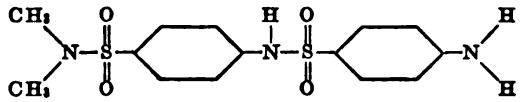
is a derivative of benzene sulfonic acid. The benzene ring is the basic constituent of almost all the effective compounds in this group.

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The common constituent sulphur is present in various functional states such as sulphonamide, sulphone, sulphoxide, etc. The *para*-position of the attached groups is essential for the therapeutic effect, the *ortho* and *meta* compounds being inactive. It is believed (5) the amine attachment to the benzene ring is more important than the sulphonamide group alone, for the anilide derivative of sulphanilic acid is as active as the amide. A number of the effective new compounds do not contain the sulfanilamide radical and conversion to sulfanilamide, *in vivo*, is considered highly improbable (8). Those substances containing this radical differ in toxicity, solubility, rapidity of excretion, and bacteriostatic action. This variability seems dependent on ease of reduction, mode of administration, and species of animal. Many new compounds have been synthesized but few have received extensive evaluation although some give promise of greater value than sulfanilamide. Disulon, Diseptal C or D. B. 32,



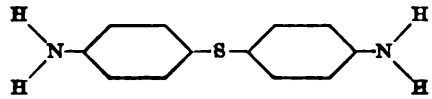
is poorly soluble, slowly absorbed, and relatively ineffective given orally, but more effective against streptococci when given subcutaneously (6). It is less than one-fifth as toxic as sulfanilamide, and is considered superior against staphlococcus (7) (123), gas gangrene in mice (12) (123), and in the treatment of gonorrhea (12). The closely related dimethyl compound Uleron, Uliron, Diseptal A, D.B.90 (Uleron is the Winthrop Chemical Co. name for this drug) is



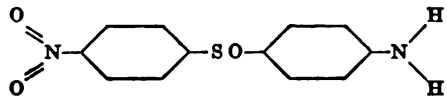
dispensed in this country as D 373, and is considered as useful as (7) (12), or by some, superior to sulfanilamide in the treatment of gonorrhea (13) (123). While this drug gave good therapeutic results, certain undesirable side actions, including a high incidence of fever and dermatitis (13), caused its withdrawal for further laboratory tests (14). The mono-methyl compound (Diseptal B, D. B. 87) is superior to sulfanilamide in therapy of gonorrhea and is probably the best agent of this series (13). According to Hörlein none of these three compounds can be reduced to sulfanilamide (7). The sulphone compounds (diaminodiphenyl dinitrodiphenyl) are effective in curing streptococcal infections in mice, do not contain the sulfanilamide radical, and conversion to it is considered improbable (8). The former is effective in $\frac{1}{100}$ the dosage of sulfanilamide but is 25 times as toxic and this precludes its clinical use (190). The latter is effective

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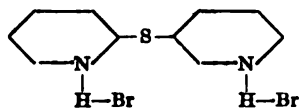
in the same dosage, is less toxic for mice, but not for rabbits (8) (9). In reporting on thioaniline,



evidence was adduced that several compounds in which the sulphur has different chemical functions are able to favorably alter streptococcal infections in mice (9). A pyridine compound which contains the benzene sulfonamide group and has the amine group replaced by a pyridine nucleus has a powerful anti-streptococcal effect *in vivo*, is readily soluble and practically nontoxic for rabbits and mice (10). It is probably not converted to sulfanilamide in the body. A sulphoxide



compound, 4 nitro=4′ aminodiphenyl sulphoxide, appears to be a potent anti-endotoxic agent (gonococcus and B. *aertrycke*) (11). Cumulative experimental evidence thus demonstrates that neither the sulfonamide group nor the amino group is essential for therapeutic action. Even sulfanilic acid itself has some protective action. In a comparative study of pyridine and benzene nucleus compounds against streptococci in rabbits, Kolmer reports greater possibilities with the former, particularly when containing divalent sulfur in the molecule (13a). He obtained especially encouraging results with 2:2 pyridylsulphide dihydrobromide



Curative Results

In the evaluation of statistical results it is unsafe to be dogmatic, for so many variable factors enter into the outcome of therapy. In assessing the value of sulfanilamide, many clinicians have been concerned lest reduction in mortality rates be the result of depression of virulence with latent infection persisting, but competant analysts credit clean-cut bactericidal action.

Hemolytic streptococcic infections.—The giving of Prontosil for 3 to 5 days was found to save the lives of a large majority of mice infected intraperitoneally with 10 fatal doses of a mouse-virulent strain of *beta*-hemolytic streptococcus (2). Further evidence of this type has been listed (1). Such experimental work has shown that prolonged survival of all treated animals is rare, and living cocci can

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be obtained from the blood or tissues of treated mice long after untreated controls have succumbed. The mouse develops little natural resistance to such infections. These results have been duplicated, using human bone marrow cell cultures and infecting with virulent hemolytic streptocci (64). The cells disintegrated in controls as the bacteria rapidly multiplied. The sulfanilamide-treated cultures appeared to be sterile after 24 hours, but in 48 to 72 hours streptococci gradually became evident in increasing numbers. However, the tissue cells remained uninjured for days providing the sulfanilamide was replaced with a fresh solution every 48 hours. While these organisms retained full virulence on subculture, they apparently were rendered harmless saprophytes by the presence of sulfanilamide.

PUERPERAL INFECTION WITH HEMOLYTIC STREPTOCOCCI.—The average fatality rate for all such cases is 15 to 25 percent. It is lowest in those cases with a localized infection of the endometrium, highest (50 to 70 percent) in those with bacteriemia, peritonitis, or thrombophlebitis of the pelvic veins with metastases (18). The carefully and conservatively reported series of Colebrook and his colleagues are representative of the general experience, a review of which has appeared (14). In an early report, they included thirty-eight drug-treated cases with a mortality of 8 percent as compared to 26.3 percent in the preceding 38 cases (19). Their average mortality over the preceding 5 years was 22.8 percent. They noted the streptococci could be cultured from the discharge of treated cases as often and for as long as in previous cases. In a later report they present 199 treated cases with a death rate of 5.5 percent and a reduction of hospital stay from 51.3 to 19.7 days (20). In bacteriemic cases the mortality was lowered from 71 percent to 40 percent.

This representative experience shows control of infection spread, reduced morbidity, a shortened hospital stay and a reduction of the mortality from 15 or 25 percent to 5.5 or 8 percent and in bacteriemic cases from 71 to 40 percent. Its value is self-evident.

Two preparations readily reduced to sulfanilamide have been used prophylactically (15 gr. 4 x daily for 4 days, 7½ gr. t.i.d. for 3 days during the first week after delivery) for a year, in alternate cases (159) The general results proved negative. In this connection it has been shown that sulfanilamide given to pregnant mothers near term diffuses through the placenta into the infant's blood in about equal concentration (175). There were no complications observed in a small number of cases but it may interfere with an infant's breathing. This data has been confirmed (214) and a note of warning is sounded (213) relative to the effect of therapy on the fetus. However children tolerate higher doses than adults (110) and clinical experience (214) thus far indicates the placental transfer is not dangerous to the fetus nor does the milk level contraindicate nursing the baby (221).

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HEMOLYTIC STREPTOCOCCUS BACTEREMIA OTHER THAN PUERPERAL.—The mortality in this type of infection prior to the use of sulfanilamide was approximately 70 percent, varying with the site of focus, age of patient, type of treatment, and in reviewing 50 cases treated with sulfanilamide Keefer reports a mortality of only 32 percent (18). A review by Duff and Holman confirms these results and reports six cases of hemolytic streptococcic peritonitis in infants or young children with three failures, two successful and one questionable result (14).

ERYSIPELAS.—This disease is characterized by wide variations in mortality rate. It is especially severe in children under 5 and in adults over 60 years of age. In a series of 631 cases treated by other methods the average hospital stay was 15 days (23). In 20 cases treated with ultra-violet light this was reduced to 8 days, in 17 cases treated with antistreptococcus serum to 12 or 14 days, and in 12 cases treated with Prontosil to 6 days. In comparing 50 drug-treated cases with 50 cases treated by other means Becker noted a constant arrest of spread and a reduction in duration (24). Twenty-three cases were reported afebrile in 2 or 3 days as compared to 11 or 30 days for cases under other forms of therapy with two failures attributed to inadequate treatment (25). In 40 patients all successfully treated it was noted the immature white cells disappeared under treatment and a drop in the total white cell count was considered a favorable prognostic sign (21). The failure of Prontosil-base therapy in an infant was attributed to lack of absorption from deficiency of gastric acidity (22). When dilute HCl was given with the base the patient promptly responded. In a series of 270 cases, 135 were treated by ultra-violet light and 135 with sulfanilamide. Spread stopped in 2 days in 99.33 percent of the drug-treated cases and in 72.9 percent of the others. Pyrexia persisted over 3 days in 9.6 percent of the drug-treated cases and in 40 percent of the others. These authors consider sulfanilamide superior to both ultra-violet light and specific serum (26). In another 27 cases the results were considered excellent (35). Long reported it highly effective in about 50 cases, the lesion stopped spreading within 16 hours in every case (80). Of 35 cases 33 regressed in 48 hours and the one relapse responded to a second course. All cases had a normal temperature in 45 hours. The dosage, orally, 10 gr. t.i.d. The hospital days were 18.4 for the drug-treated cases and 23.8 for a control series (87). In reporting on 26 cases in which fever, leukocytosis, and cutaneous lesions abated in 24 to 48 hours this was considered the therapy of choice (100). The use of sulfanilamide is credited with reducing the duration of the disease from 13.9 to 5.3 days, lessening spread from 66 percent to 11 percent, and curing two cases in infants with a positive blood culture. Abscesses developed in two of these cases and three of the 27 died. These deaths were not considered

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related to the disease or therapy, one had pulmonary tuberculosis with liver necrosis and acute nephritis, one had a cerebral hemorrhage, and one had renal insufficiency (112). The Mayo Clinic considers this therapy of great value (130). Musser considers it of little value (80).

Conclusion: The use of sulfanilamide in therapy of erysipelas has been almost uniformly successful. It is credited with favorably influencing the spread, fever, complications, and morbidity and it shortens the course, prevents recurrences, and lowers the mortality.

MISCELLANEOUS ORAL INFECTIONS.—Throat infections caused chiefly by *beta*-hemolytic streptococci and including septic sore throat, tonsillitis, and cervical cellulitis have been treated with sulfanilamide. Holman and Duff have reviewed some two dozen such reports (14). Clinical opinion is favorable for accelerated recovery but not for the eradication of streptococci (143). For instance Hageman found hemolytic streptococci in the throats of seven tonsillitis cases up to 5 weeks following drug administration (28). Smith cultured hemolytic streptococci from the throats of 31 cases occurring during an epidemic. They responded remarkably to sulfonamide therapy (48 hours) but 5 cases relapsed in 2 to 4 weeks and positive throat cultures persisted up to 5 weeks after recovery suggesting an increased carrier rate (29). The Mayo Clinic considers it of great value in these cases (130). Conclusions: Sulfanilamide therapy accelerates recovery. The streptococci persist in foci as the tonsils and relapses occur. It may prove essential to continue therapy in reduced dosage for a period after recovery. The necessity for tonsillectomy, or eradication of foci, remains.

OTITIS MEDIA AND MASTOID INFECTIONS.—In treating 11 *beta*-hemolytic streptococci otitis media cases with sulfanilamide, all recovered with no complications and no operative procedures were required and 15 similarly infected mastoid cases were successfully treated and only 2 required operation (112). Six cases of middle ear and mastoid disease with complications (4 meningitis—one sterile, one post scarlatinal mastoiditis, and one perisinuous abscess with septicemia) were cured (99). A type V and another untyped pneumococcus mastoid case both died regardless of treatment (34). There are numerous reports in the literature of the successful treatment of *beta*-hemolytic streptococcus meningitis secondary to mastoid disease and it has been recommended giving sulfanilamide prophylactically in streptococcus infections of the middle ear and mastoid because of its known value in limiting the spread of these organisms (191). This would be particularly valuable when surgery is contemplated.

RHEUMATIC FEVER.—Massell reported on six cases with *beta*-hemolytic streptococci present in the throat and drug therapy was given, two recrudesced, one died, and one developed a cervical ade-

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nitis (30). In a later report he found no benefit in 58 cases or in 7 patients with chorea (167). Apparently there is little or no benefit from using sulfanilamide after the onset of the disease, for the therapy tends to increase fever, leukocytosis, sedimentation, and pulse rates (105a). Its value is considered questionable (130) and since streptococci persist in infected tonsils, the indications for tonsillectomy are not changed (28) (29) (105a) (143).

SCARLET FEVER.—In reporting on 150 cases treated with Saptazine (a compound readily reduced to sulfanilamide) comparison was made with 150 control cases, 56 of which received antitoxin. Of the drug-treated cases 35 percent developed complications as compared with 56 percent of the latter (27). In a report on seven treated cases there were no complications, but the toxic phase was not influenced (112). Others have reported prompt remission of fever and decrease in glandular enlargment (71) and lessened complications (54). In another series of 100 sulfanilamide-treated cases the incidence of complications was 8 percent, whereas in a similar control group it was 41 percent (201). No appreciable acceleration in recovery rate occurs (35) (201), and there is little influence on the acute disease (143). The drug may prove beneficial in reducing the incidence of complications, and further trial in prophylaxis seems warranted.

ARTHRITIS.—Domagh successfully treated rabbits with chronic, experimentally induced, hemolytic streptococcic infections in which the joint tissues were swollen and endocarditis was present (2). Smith treated two gravely ill septic cases of acute arthritis of the hip (hemolytic streptococci) with recovery (29). The Mayo Clinic considers its value in infectious arthritis and fibrositis as questionable (130) (215).

MISCELLANEOUS HEMOLYTIC STREPTOCOCCAL INFECTIONS.—Good results are reported in experimentally induced sinus infections in rabbits (219), in a case of post-influenzal pneumonia with pleurisy (27); two cases of osteomyelitis (31); two cases of post-influenzal empyema when given intrapleurally (32); in streptococcal pneumonia (33), (112), (142); five cases, three of which had empyema (28) (two received thoracotomy also); an empyema in a baby (thoracotomy also); one case of extensive suppuration in the cellular and bony tissues of the pelvis (20); three cases of traumatic orbital cellulitis (31); and in orbital cellulitis cases (130). The drug has also proved useful in limiting the course and preventing abscess formation in puerperal mastitis cases (126f). A death is recorded of a 1-year old boy with a 10-day post-pneumonia empyema (34). The intrapleural use of these drugs is cautioned against, for in rabbit experiments the treated rabbits died more quickly than the untreated ones (162). If this proves true it may well be explained on the basis of the initial stimulatory action on streptococci which has been noted *in vitro* (165).

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HEMOLYTIC STREPTOCOCCAL MENINGITIS.—The subject of meningitis including meningococcus infection will be presented in another article. Suffice to say that in *beta*-hemolytic streptococcic meningitis with a fatality rate of 97 to 100 percent the mortality has been remarkedly reduced. In a series of 52 cases of meningococcus meningitis treated with sulfanilamide, the mortality was 15 percent, as compared to a mortality of 30 percent among patients treated with antiserum during the same epidemic and in the same hospital (35). A case of anaerobic *beta*-hemolytic streptococcus meningitis of otitic origin was treated with sulfanilamide with complete recovery (166). A case of *gamma*-nonhemolytic streptococcus meningitis received the equivalent of 1,164 grains of sulfanilamide and recovered (163).

STAPHYLOCOCCAL INFECTIONS.—No inhibition has been noted *in vitro* (16), (58), (71). The first favorable reports were by Domagh though the results were uncertain in both acute and chronic infections (2). Then Buttle was able to protect mice, with sulfanilamide, against 1,000 fatal doses of a bovine strain (36). The urine of sulfanilamide treated patients is reported to be bactericidal (37) for staphylococcus and the three Diseptal compounds are reported more effective in mice (7) (123). These organisms lack constant or high virulence and possess feeble invasive qualities, thus lending themselves poorly to experimentally induced infections for drug study. The clinical results have likewise been difficult to assess. Many and varied cases have been treated and the consensus credits the drug with some curative action and occasional dramatic effect (14), (20), (186), (190). Apparently the newer compounds give more promise (123).

PNEUMOCOCCUS INFECTIONS.—The inhibitory effect *in vitro* has been noted (1) and reaffirmed (36) (58). In animal experiments the sulfones are superior to sulfanilamide and a marked prolongation of life occurs but few animals permanently survive as a result of therapy (129). The diaminosulfone compound, while more toxic is 20 times as effective as sulfanilamide in prolonging mouse life (8), though as with the latter (138), cure is uncertain. In experimenting with 64 related sulfanilamide compounds Whitby found 2-(*p*-aminobenzenesulfonamido) pyridine to possess great chemotherapeutic activity against pneumococci of several types. It was credited with inducing degeneration and disappearance of the capsule with loss of type specificity (195). Its mode of action is apparently similar to that of sulfanilamide (207). It is effective in low dosage, the animal toxicity is low and there is evidence it does not produce porphyrnuria.

Its successful use clinically has given a mortality rate of 8 percent in 100 cases as compared to 27 percent in a similar control series given other forms of therapy (203). The drug has been used in this country and further study is promised (204). A species influence has been shown by greater drug effectiveness in pneumococcic peritonitis in

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rats than in mice or rabbits (6). Sulfanilamide is considered as effective as serum and the combination of drug-serum therapy is credited with results superior to either alone (39) (40) (41). The effectiveness depended on the size of the infective dose and the interval between infection and initial treatment and while the course and the extent of the pneumonia was not affected, toxemia seemed to be combated (41).

Early institution of therapy has been found essential for survival of mice and rabbits (42) (43). In using the drug clinically 7 of 9 type three pneumonias recovered while of 10 not drug-treated only 2 recovered (44). Of seven *beta*-hemolytic streptococcal pneumonias treated all recovered (112). Two type III failures are reported and of two type I cases, one recovered and the other died, while one type II pneumococcemia recovered (34). Six cases (types I, II, and III) are reported as being cured with sulfanilamide and there are other scattered references to its use (223). The consensus is favorable, especially when combined with specific sera. Since this is apt to promote methemoglobinemia it may aggravate the anoxemia of pneumonia (176). Such a case is reported in a patient with streptococcal pneumonia in which 22 percent of the total hemoglobin was so involved (45).

Conclusion: The pneumonia advisory committee to the Surgeon General, United States Public Health Service considers, "the experimental results are sufficiently impressive to warrant further and extensive investigation of the pneumococcidal power of this compound (sulfanilamide) and related compounds. Whenever it seems advisable, clinical trial of such substances with or without the simultaneous administration of specific immune serum should be made on a fairly extensive scale, with careful controls for comparison" (116).

URINARY TRACT INFECTIONS (nonspecific).—The bacteriostatic effect of sulfanilamide containing urine has been demonstrated by using it instead of broth in culture media and diluent (46). Given in adequate amounts it is bactericidal to B. *coli* and *Staphylococcus aureus* in the urine and prostatic secretion of dogs (109). It is considered a promising urinary antiseptic (48) that has proven efficacious in the treatment of all common urinary tract infections except streptococcus fecalis and has the advantage over mandelic acid in that the urine need not be acidified (47). In fact a pH of 7.5 desirable for the bactericidal effect is thereby enhanced. This makes sulfanilamide particularly useful in treating urinary tract infections due to *Proteus ammoniae* which are so resistant to mandelic acid because of the difficulty in acidifying the urine.

About half of all organisms from the urinary tract are susceptible to a concentration of 50 mg-percent of free sulfanilamide in the urine whereas practically all except the *beta*-hemolytic streptococcus of group D are susceptible to 200 mg-percent (227). Since approxi-

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mately 90 percent of ingested sulfanilamide is excreted in the urine and 50 percent of this is present in the active, free form (120), the ingestion of one gram (1,000 mg) daily would result in a urinary output near 450 mg of free sulfanilamide in say 1,000 cc of urine, or a concentration of 45 mg-percent. Thus the optimal dosage is easily calculated. In a series of 46 cases of B. *coli* infections this treatment resulted in disappearance of clinical symptoms and sterile urine in a few days (49). A large number of bacteria, isolated from these cases, were found susceptible in varying degree to the sulfanilamide containing urine from the treated cases. The clinical response was apparently unrelated to sensitivity of bacterial strains, various other favorable reports have appeared in the literature.

Pyelitis is treated by ketogenic diet and mandelic acid only in the subacute and chronic stages (47a). Sulfanilamide possesses the advantages of being safely used in acute cases, in ease of administration, less tendency to cause gastro-intestinal upsets, and it does not require as good renal function as does either the ketogenic diet or mandelic acid which must reach a concentration of 0.5 percent in the urine to be effective. When given before or shortly postoperatively in prostatic cases it has proven of little value (108). It is not the urinary infections existing at the time of operation that are considered responsible for a stormy convalescence. Rather this is due to the organisms introduced at the time of operation. Against these the drug appears to have little immediate effect. It seems effective only after the body has developed some immunity since the urine clears almost immediately with treatment (10 gr q 4 h) 4 to 6 weeks postoperatively (107). However, others do consider it effective when given immediately, postoperatively, to prostate cases providing a concentration of 20 to 30 mg per 100 cc is maintained in a urine with a pH of 7 to 8 (164).

VIRUS DISEASES.—Prontosil was found to be without effect in experimental herpes (encephalitic strain) and lymphogranuloma inguinale (60). Negative results have been reported in experimental poliomyelitis in the monkey (61), clinical poliomyelitis in man, and with the St. Louis type of encephalitis virus and the influenza virus; however it proved effective against the virus of lymphocytic choriomeningitis in mice (38). Dochez reports sodium sulfanilyl-sulfanilate to be curative of dog distemper virus disease in dogs, cats, and ferrets (93), and this work has been corroborated by Marcus and Necheles (205). This substance is reported to be ineffective in experimental influenza infections but a group of related sulphur derivatives are reported as capable of favorably influencing the course and eventual outcome of the experimental disease (197), and Oakley found the dextrose derivative of 4:4′-diaminodiphenylsulfone to have a slight but significant action in curing mice (209). This latter substance

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and sulfanilamide have been found to exert some protective action for mice infected intracerebrally with the virus of lymphogranuloma inguinala (208). By similar experiments Levaditi has demonstrated a protective effect with 4-sulfamido-phenyl-azo-3.5 diamino-benzene and p-aminophenylsulfamide (210). Shropshear has reported clinical improvement in both the bubo and the rectal complications of the diseases with sulfanilamide therapy (211).

MALARIA.—Sulfanilamide was not effective against avian malaria in canaries (36). Fifteen cases of benign tertian (57) and two cases of quartan malaria (139) were successfully treated with Prontosil. Another report credits Prontosil with cure of seven cases of benign tertian and ninety three cases of quartan malaria. The drug was given intramuscularly (10 cc. b. i. d.), and cure required an average of only four injections. There were two reinfections, no relapses. However, the toxicity of the drug and the efficiency of established antiplasmodial agents are considered to preclude its general use (90).

BRUCELLOSIS.—The coccus, bacillus, or coccobacillus known as Brucella is apparently responsive to sulfanilamide. It was found ineffective *in vitro* (52) and in guinea pigs (59) but others have demonstrated a bactericidal action *in vitro* (58) and curative action in guinea pigs experimentally infected (174). The successful therapy of clinical cases is evidenced by the following case cures, 1 case (55), 3 cases (103), 1 case (140), 5 cases (174), 1 case (192), 2 cases (202) and Blumgart (192) cites 12 additional cases reported from Europe. In using neoprontosil orally Neumann (224) reports 15 cures in 16 patients whereas of 4 patients who received a smaller dosage intramuscularly only 1 was cured. Blumgart calls attention to the fact that recovery occurred only after from 4 to 9 days of sulfanilamide therapy and that in one case studied the blood culture remained positive a week after apparent clinical recovery. In one of the cases cited above cure followed the administration of 7 grams of sulfanilamide in 36 hours (103).

GAS GANGRENE INFECTIONS.—A bacteriostatic action (increasing in the order: Prontosil soluble, sulfanilamide, disulfanilamide) was demonstrated against c. *tetani*, *lentoputrescens*, *novyi*, *septicum* and *histolyticum* (106). However c. *welchii* and the intensely proteolytic types as c. *sporogenes* and *bifermentens* and also the toxic c. *botulinum* type A were scarcely affected. Domagh using the Disulon series found the action on c. *welchii* inconstant but with paraanthrax uniformly good results were obtained (123). Sulfanilamide is credited with inactivation of perfringens hemotoxin *in vitro* but not tetanus neurotoxin (64), and definite inhibition of c. *welchii* in mice has been shown (80). The combined use of sulfanilamide and antitoxin was successful in treating two cases of c. *welchii* infection and one presumptive case of gas gangrene infection (62). This evidence seems

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to indicate a definite effect on gas gangrene organisms. However the importance of a streptococcic bacteremia as the cause of death in gas gangrene is not to be overlooked, and since the streptococcus is credited with causing many gas gangrene deaths this may partially explain the beneficial effect of these drugs (141)

TUBERCULOSIS.—Sulfanilamide is credited with modifying the development of experimental tuberculosis in the guinea pig (115) and Marcou recommends its use in tuberculous mixed infections of the skin, bones, and viscera (114). However Frankl has found it of no benefit, and instances have occurred in which the disease was made worse by its use (186). The use of neoprontosil (Prontosil soluable) at the Mayo Clinic was without effect (215).

SYPHILIS.—No effect was obtained in experimental syphilis in the rabbit (56).

INFECTIONS ABOUT THE EYES.—In ophthalmia neonatorum the use of sulfanilamide (0.2–0.25 gm per kilo daily) resulted in more rapid cure than had ever been noted (88). In another case a negative smear was obtained in 36 hours (28). Newman reports favorably upon the use of the drug in presenting eight cures in infants (189), and a report of eight adult cases shows rapid cure without hospitalization (218). The combination of sulfanilamide and fever therapy was used in one case, and considered superior to either alone (160). In successfully treating three cases of gonorrheal ophthalmia Lieutenant-Commander Ray Hege, Medical Corps, United States Navy in a personal communication to the author, considers the drug a valuable adjunct to established procedures. A severe orbital cellulitis, secondary to a pimple on the face, and parotitis recovered promptly with sulfanilamide therapy (91).

TRACOMA.—Though not a specific the drug is considered a valuable aid to mechanical methods (173). Its use in 30 cases improved the conjunctivitis and corneal lesions and lessened photophobia and lacrimation. In a recent report of the results in 140 cases Loe noted markedly good results and Gradle in discussion of the report concurred (212).

CHANCROID.—Hanchell treated 20 cases with sulfanilamide and noted rapid healing without scar and subsidence of bubo in 5 to 10 days (178). These results have been confirmed and for 11 cases treated, the hospital stay was reduced from 46 plus to 15.5 days (184). In further reports cure was effected in 10 cases in from 5 to 11 days (187) and in 45 cases in 2 weeks or less (188).

CHRONIC ULCERATIVE COLITIS.—It appears that both sulfanilamide and neoprontosil effect improvement and possibly cure a proportion of these cases (215), (216), (217).

TYPHOID AND SALMONELLA GROUPS.—*In vitro* inhibition has been noted against S. *aertrycke* and B. *typhosus* (36) though the latter was

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not confirmed (71) and certain salmonella strains, including paratyphoid A and B, were not inhibited. Failure in experimental infections in mice with paratyphoid organisms led to the conclusion it is not useful against these types (14). A 75 percent survival of B. *typhosus* infected mice was obtained upon treatment with sulfanilamide though positive cultures could be obtained from blood or tissues a month later (52). A case of typhoid bacilluria was cured (53) but Prontosil proved valueless in treating the bacilluria in an epidemic of typhoid fever (54). These reports are certainly not favorable.

MISCELLANEOUS FINDINGS.—To the use of sulfanilamide is attributed control of a streptococcic epizootic in lambs (50), the cure of bovine mastitis (51) and a favorable response in two cases of pemphigus (98), one case of infectious mononucleosis with severe sore throat (130), and two cases of infectious mononucleosis (215). After nine successive cases of plague had died Carman began using Prontosil (2.5–5 cc b. i. d.) and of the next six cases so treated, three recovered (89).

No effect was noted on trypanosomes *in vitro* (73), or in mice (36), or against virulent Friedlander bacillus in mice (59). It failed to protect mice against B. *typhi murium* (58). No effect was noted on diphtheria toxin (64) or in a case of tularemia (215). The anaerobic streptococci are resistant to sulfanilamide both *in vitro* and *in vivo* (226). Subacute bacterial endocarditis is the most serious disease caused by the *alpha*-streptococci which are generally inhibited in their growth when cultured in beef infusion broth with 1:10,000 concentration of sulfanilamide and soft tissue and urinary tract infections due to this organism subside promptly with this therapy (226). However the course and outcome of subacute bacterial endocarditis are unaffected by therapy even though the bloodstream may be rid of organisms (131), (215), (226). It is credited with a protective action on hemolytic streptococcus of Lancefield's group C in guinea pigs (56a). This organism is causative of strangles in horses, which disease is satisfactorily treated with sulfanilamide, whereas *beta*-hemolytic streptococci of groups D and E are resistant (226). *In vitro* inhibition has been shown against *alpha* and *gamma* streptococci, neisseriae (throat), M. *tetragenus* and two hemophilus cultures (71) and molds (72), but not against strains of B. *dysenteriae* (71) or B. *coli* (16) (58). The combination with immune serum appears to have some added curative action on otherwise fatal innoculations of influenza bacilli, isolated from spinal fluid, in mice (113), although Rosenthal was unable to demonstrate any inhibition against H. *influenza in vitro* (38). The successful treatment of a case of influenza bacillus meningitis has been reported (168).

GONOCOCCUS INFECTIONS.—The initial favorable reports in this country have been noted (1). In contrast Prontosil was considered

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to have little activity (13) to be unsatisfactory (65) or a complete failure (24). Sulfanilamide has been termed inconstant though it tended to reduce the numbers and cause disappearance of gonococci (13). *In vitro* studies on gonococci showed the inhibitory effect of the Diseptal compounds and of Prontosil within concentrations obtainable clinically (95). Some of the strains which were resistant *in vitro* proved resistant clinically, though this has not been confirmed (96). The organisms from fresh cases tended to be more resistant while those from old cases were more sensitive. In dilutions of 1:10,000 sulfanilamide proved bacteriostatic *in vitro* though to demonstrate gonococcidal action it was necessary to study cultures for hours rather than the 20 minutes usually alloted antiseptics (110). It has an inhibitory effect in dilutions of 1:1,000 in 5 hours or up to 1:1,000,000 after 24 hours incubation at 37.5° C. with cultures of gonococci and has a protective action for mice (96). Having demonstrated that white mice can be infected with gonococci by intraperitoneal infection it is shown that such inoculation of cultures suspended in mucin, results in 95 percent deaths in 24 to 48 hours (11) (94). In some fatal cases the peritoneal cavity contained many intra- and extra-cellular cocci. In others the cocci were absent, apparently having been lysed, and death seemed due to endotoxins (11). In testing the protective action of 60 sulfur derivatives by this method, 4 nitro-4-aminodiphenyl-sulfoxide (No. 62) protected 100 percent of mice with 5 mg for a 20 gm mouse (94). Indefinite survival was the criterion for cure. The minimum effective dose is 1/100 of the tolerated dose. Uliron in 15 times the dosage, and sulfanilamide in 10 times the dosage, were less effective.

Following treatment of 19 cases of gonorrhea, of less than 1 month's duration, with *para*-amino phenylsulfamide (1,162 F), 17 were cured under 20 days (average 10). In cases of 30 to 60 days' duration, 10 of 12 were cured in 6 to 28 days (average 17) and in 13 cases of over 2 months' duration 8 were cured in 12 to 25 days (average 17) (97). In using *para*-amino phenylsulfamide in 100 males with acute urethritis (no irrigations) in 66 the urine cleared by the fifth day, gonococci disappeared by the seventh day and the morning drop by the fourteenth day, with no recurrence on beer and coitus (85). In 29 similar cases treated also with irrigation (daily 1:7,500–1:10,000 $KMnO_4$) similar results were obtained in 19, moderate results in 6 and there were 4 failures. In 33 chronic cases (without irrigation) good results were obtained in 18, moderate results in 12 and there were 3 failures, while in 13 chronic cases also treated with irrigation, good results were obtained in less than 3 weeks in 5, in 4 weeks in 4 and mediocre results in 4. In 70 cases in females the results were slightly less favorable (85). In treating 24 cases with *p*-benzyl-amino-

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benzene-sulfonamide (600 gr. in 10 days) only 2 were improved (86). Of 64 given sulfanilamide (5 gm/2–3 days, 4 gm/2–4 days, 2 or 3 gms up to 10 days) over 50 percent were failures. The low incidence of complications was noted, only 8 of the 27 cases of anterior urethritis developing posterior extension. There were two cases of epididymitis and one periurethral abscess. In testing new preparations the Diseptal triad was found superior to sulfanilamide with 24 cures in 36 acute and chronic cases, both sexes (13). The Diseptal B compound proved best. An 87.3 percent cure is recorded for sulfanilamide in 104 male and 30 female cases (67). Of 250 treated cases a small group failed to respond but chronic urethritis and prostatitis cases cleared as rapidly as acute cases (68). Similar results have been reported elsewhere (182). In another group of 72 cases treated there were 12 complete failures and only 14 cures (151). In a series of 72 acute and chronic cases (66 males, 6 female) cure was established in from 2 to 40 days in the males and 12 to 30 days in females (153). Of 63 acute cases 40 were cured in 18.2 days (average), 6 required an average of 54 days, 7 were hospitalized and 10 relapsed after initial response (180). The following results were tabulated to demonstrate the greater effectiveness in chronic cases (148).

Dosage	Acute cases		Chronic cases (25+ days duration)	
	Cure	No response	Cure	No response
20 gr 4 x/day	17	8	13	1
20 gr 6 x/day	31	7	21	0

These results indicate the added value of higher dosage, of more frequently administered dosage, or of both. In a series of several hundred acute and chronic cases treated with sulfanilamide and established procedures, 10 percent of anterior urethritis cases recovered promptly (double the percent without the drug) and it proved valuable in lessening the pain and discomfort of acute posterior urethritis (63). In males with acute uncomplicated urethritis an 88 percent cure is recorded in 25 cases (146), a 70 plus percent cure in 30 cases (147), in males a 90 percent cure, and in females an 80 percent cure (130). In well developed acute cases one-third are cured in 10 to 30 days, another third in 30 to 60 days, and one-third fail (110). Similar results are reported by Ainsworth (179). A 2 to 4 weeks cure is reported in two-thirds of chronic cases with better results in those acute cases who had previously had gonorrhea (150). Knight reports a 24.93 day cure in 30 chronic cases compared to 43.9 days in 30 chronic cases using standard procedures (180). It has been noted

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that patients may fail to respond to the first course of sulfanilamide but are readily cured by a second course (154), (155), (182). This is considered dependent on immunity development in the interim.

Reporting on use of Diseptal A, Felke stressed the importance of tissue reactions in determining final cure of gonorrhea, regardless of the treatment used (12). Local therapy was not used in acute cases but a few irrigations after 5 to 6 weeks proved of definite aid in final cure. He noted persistence of gonococci even though signs and symptoms disappeared in 1 to 3 days. In ambulatory cases he allowed 2 weeks to elapse before giving any drug. He noted no inhibition of the gonococcus by the blood of treated patients; a finding at variance with that of Keefer who found blood and the synovial fluid of infected joints, bactericidal for the gonococcus (69), the organisms disappearing from this fluid in 2 days (2 cases) under sulfanilamide therapy. A third case of arthritis was successfully treated. In one of these cases the bactericidal content of the blood and synovial fluid increased greatly in less than a week (69a). Two cases of arthritis were cured with *para*-amino-phenylsulfamide. A third responded but relapsed while under treatment (101). The advantages of combining chemotherapy and thermotherapy have been stressed (70), especially in the 10 percent of resistant cases (177).

A gonorrheal meningitis case was cured with sulfanilamide. This case relapsed several times when treatment was discontinued but resumption of therapy brought it under control each time (122). In treating vulvovaginitis in children each course of sulfanilamide was given for 21 days. Seven cases were cured with one course, nine with two, and only one more with each the third and fourth courses, thus demonstrating the futility of indefinite administration (110). Others report favorable results in vulvovaginitis (28), (111), (172) and it is considered a useful form of therapy (48), (156). In another series approximately 20 percent were promptly cured and 40 percent benefited (171).

Consensus of opinion regards this chemotherapy as a valuable adjunct to established local therapy (114) and while it has been said that 30 percent of cases recur (128) this has not been true in my experience nor does the American literature bear this out. We are warned the time of cure is more difficult to determine and that this therapy changes the microslide characteristics of the gonococcus (157).

It is desired to review the cases treated in connection with this study. Cases 1 to 15, reported previously (1), are included here for statistical purposes. The dosage in these 15 cases approximated 4 grams daily for 2 days, 2 grams daily for 6 days, 3 grams daily for 6 more days. They received no local therapy while on sulfanilamide.

Cases 16 to 44, currently reported, received a higher dosage,

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approximating 5 grams per day for 2 days, 4 grams per day for 3 days, and then 5 grams per day for 5 or more days. These latter cases on the whole received no local, oral, or dietary therapy prior to or during the first course of sulfanilamide. When this was completed local therapy was given to cure regardless of further drug therapy. Sex and alcohol were prohibited, regular duties continued. Each case was observed daily. No fluid restriction was attempted. Therapy was instituted in each case when he presented with initial symptoms and white and differential blood counts were made at least every other day.

These cases are presented in table I.

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TABLE I

Case No.	Clinical condition on admission [1]	Complications	Sulfanilamide treatment [2]				Local treatment started and continued to cure [2]	Clinical course [2]				Remarks
			First course [3]	Second course				Last + smear	No A.M. tear	2-glass test normal	Cured	
			Response	Started	Duration	Completed						
1	Ant	None	Prompt				None	17	9	9	20	The initial course of sulfanilamide was continued up to the day local therapy was started.
2	do	do	do				None	5	13	15	10	
3	do	do	do				None	11	13	15	15	
4	do	do	do				None	7	9	11	10	
5	do	do	do				None	3	3	3	5	
6	do	Prostatitis sixth day.	Improved with decreased discharge.				33	86	88	90	90	
7	Post	Epididymitis eighteenth day.	do				45	90	94	96	100	
8	do	None	do				31	94	92	98	100	
9	Ant	do	Improved after tenth day.				25	50	51	58	60	
10	Post	do	Improved				33	88	90	92	100	
11	Ant	Prostatitis seventh day.	None				27	90	90	94	90	Tenosynovitis, twenty-fourth day.
12	Post. (chr.) 2 months duration.	None	Prompt				33	17	5	5	20	
13	Ant. (chr.) (50 days)	do	do				23	15	15	15	20	
14	Ant. (chr.) (20 days)	do	Improved with decreased discharge.				35	55	55		60	
15	Post. (chr.) (30 days)	Vasitis on day of admission epididymitis on seventh day.	do				60	85	90		90	Case No. 15 presented a fiery red acutely inflamed pouting urethral orifice throughout. In this sense it wasn't a chronic case on admission.
16	Post	Osteoarthritis thirtieth day.	None until twentieth day.				29	73	75		75	Onset of late complication indicates lack of resistance.
17	Post. Urethral soreness.	None	Relief of soreness	54	4	58	12	53	60	60	60	Drug hastened cure on second trial.
18	Ant	do	Prompt				13	9	13	17	15	
19	Post	do	None	27	8	35	11	55	103	109	110	Third course (12 days on forty-first day), fourth course (12 days on sixty-fifth day).

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20	do		Partial	27	5	32	9	17	29	31	20		
21	Ant	Prostatitis sixth day.	None				10	45	82	82	90		Third course 36 to 48 days. Paresthesia, knee. Disappeared on drug withdrawal.
22	do	None	Prompt				11	5	7	7	10		WBC 4,950 on eleventh day—leukopenia.
23	Post	do	Slight decrease of discharge.	23	8	31	16	59	31	45	60		Second course cure.
24	do	do	None	28	15	43	12	85	97	99	90		Partial response to second course.
25	do	do	Favorable	35	13	48	1	53	43	34	60		First course sulfanilamide eleventh-twenty-sixth days.
26	Ant	Burning on urination.	Burning stopped on change in discharge.	32	15	47	17	32	39	53	40		Second course cure, mild rash thir teenth day.
27	do	None	Prompt				12	2	3	6	5		
28	Post	Same as No. 26.	do				23	26	37	40	40		Relapse twenty-third day.
29	do	do	Same as No. 26.				14	27	43	35	40		
30	do	None	Improved				14	59	61	62	60		
31	Ant	do	Good				15	15	7	11	20		
32	Post	Periurethral abscess 14 days.	Same as No. 26.	34	8	42	6	31	36	40	40		Agranulocytosis? This case is discussed later.
33	Post	None. Same as No. 26.	Improved with relapse seventh day.				11	50	49	58	60		
34	do	do	Very little with fifth day relapse. Stopped burning. Cure in 7 days.				15	27	40	40	40		
35	Ant	None	Apparent cure in 7 days, then relapse eighth day.				11	47	32	33	60		
36	do	do	Prompt				13	1	2	2	5		
37	Post	Vasitis, 25-day burning.	Improved (12-day relapse).				13	33	26	36	40		Exposed to sun 2-3 days before dermatitis. Dermatitis on exposed parts eighth day cleared up without drug withdrawal.
38	Ant	Burning	Improved, burning ceased.				8	33	24	22	40		Drug fever sixth day. Mild rash eighth day on exposed parts.
39	do	None	Prompt				10	31	24	34	40		Relapse nineteenth day. Pitting oedema ankles tenth day.
40	do	do	do				16	27	13	15	30		
41	do	do	do				10	2	4	7	5		
42	do	do	Good				10	27	40	33	40		Mar. 31, 1938, slight hematuria. Apr. 1, 1938, dermatitis, macular, general drug fever 99°, cleared up immediately.
43	do	do	Prompt				17	24	27	35	30		
44	Post	do	do				1	7	10	17	20		Sulfanilamide for 14 days. Local treatment same for 20 days.

[1] Ant. = Anterior urethritis. Post. = Antero-posterior urethritis with prostatitis.
[2] Reported by day of disease.
[3] First course began at time of admission.

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Analysis

Twenty-four cases presented with simple anterior urethritis. Three of these cases (6, 11, and 21) or 12.5 percent developed posterior extension within the first week while receiving only sulfanilamide therapy. This compares favorably with the 15 to 25 percent of caser with such extension noted by Pelouze (163). There were 20 posterios urethritis-prostatitis cases on admission thus giving a total of 23 of these cases. The 21 cases of anterior urethritis are listed in table I.

Table II

Day discharged as cured	Day of last negative smear (average)	Cessation urethral discharge (average days)	Number of cases	Approximate percent
10	3.57	6	7	33.3
15	10	13	2	
20	15.7	10.3	3	33.3
30	25.5	20	2	
40	30.75	31.75	4	
60	50.65	47	3	33.3
Total (averages)	19.9	19.3	21	

Table II.—Twenty-one cases of anterior urethritis. In these cases using standard local therapy Pelouze (170) records a 6-weeks cure in 90 percent and Herrold (125), a 27-day average for cure. It is to be noted the three cases listed as 60-day cures added nearly 2/5 of the days to a negative smear. These cases (9, 14, and 35) proved quite resistant. They received only sulfanilamide for 25, 35, and 11 days respectively. Possibly the earlier institution of local therapy in these cases would have hastened cure although *table III* does not bear this out. It should also be noted that certain cases presented a positive urethral scraping (smear) after the discharge had ceased.

The posterior urethritis-prostatitis cases are listed in table II. The diagnosis of posterior extension was made on symptoms, 2-glass test and prostatic findings later in the disease.

Table III

Day discharged as cured	Day of last negative smear (average)	Cessation urethral discharge (average days)	Number of cases	Approximate percent
20	35	15	3	56.5
40		36	5	
60		49	5	
60 [1]	[1]84	90.5	10	43.5

[1] Plus.

Table III.—These cases had such little resistance, the infection extended to the posterior urethra and prostate. They were treated at first only with sulfanilamide. This was followed by local therapy and occasionally by further courses of drug therapy. They required an average of 56.7 days to a permanent negative

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smear as compared to the 61-day average cure listed by Herrold (125). This supports the contention that sulfanilamide does not influence the immunity mechanism, lack of which leads to chronicity and supports Millers' assertion that the drug is not a cure in anterior-posterior urethritis with prostatitis (149). See chart I.

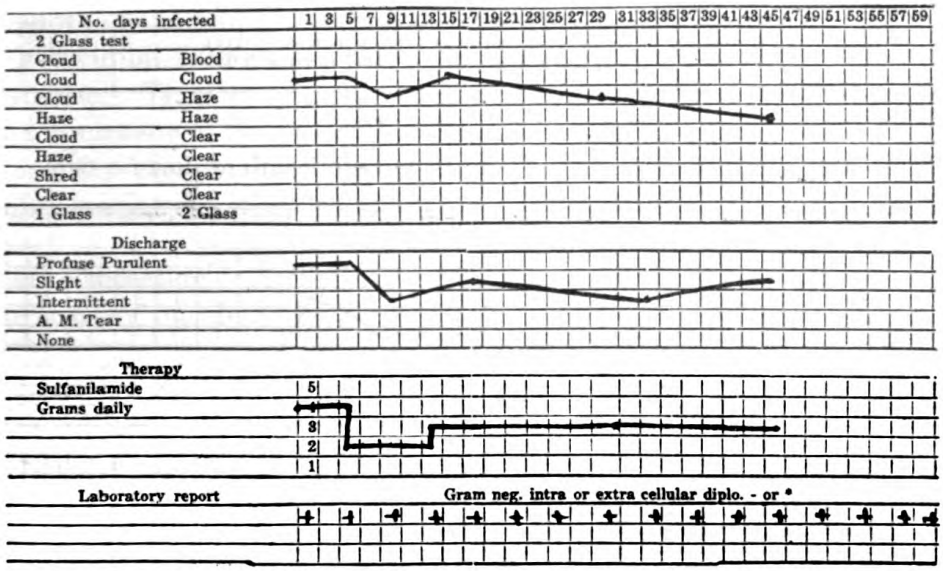


CHART 1.—Case 7 Posterior Urethritis—prostatitis illustrates complete lack of clinical improvement on sulfanilamide. It is believed this type case should also receive local therapy beginning when the early acuteness has subsided. These cases as a group respond poorly to sulfanilamide.

TABLE IV.—*Complications*

Day discharged as cured	Case No.	Complication	Day initial local therapy begun
90	6	Posterior urethritis—prostatitis, sixth day	33
100	7	Epididymitis, eighteenth day (4 bed days)	45
90	11	Posterior urethritis and prostatitis, seventh day. Tenosynovitis, twenty-fourth day.	27
90	15	Adm. with vasitis-epididymitis on seventh day (9 bed days)	60
75	16	Osteo-arthritis, thirtieth day	29
90	21	Posterior urethritis-prostatitis, sixth day	10
40	32	Periurethral abscess, fourteenth day	6
40	37	Acute vasitis, twenty-fifth day	13

Table IV.—The average, discharged cured day for this group is 76 plus. It is to be noted that the usual incidence of epididymitis is 10 percent whereas only one (case 7) developed in this group of 44 cases. The second epididymitis (case 15) is not attributable to therapy for this patient had been concealing his infection and only turned in after the onset of the vasitis. These two cases required fewer bed days than did similar cases prior to the use of sulfanilamide. The acute vasitis in case 37 followed the initial prostatic massage given by an inexperienced individual. This case did not progress to epididymitis which appears unusual.

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TABLE V.—*Local therapy*

Number of cases		Average days to a permanent negative smear
10	Permanent negative smears prior fifteenth day	3½
15	Local therapy begun prior fifteenth day (first to fourteenth day)	43 [1]
19	Local therapy begun after fifteenth day (fifteenth to sixtieth day)	48 [1]

[1] Plus.

Table V illustrates the relation of local therapy to length of time for cure.

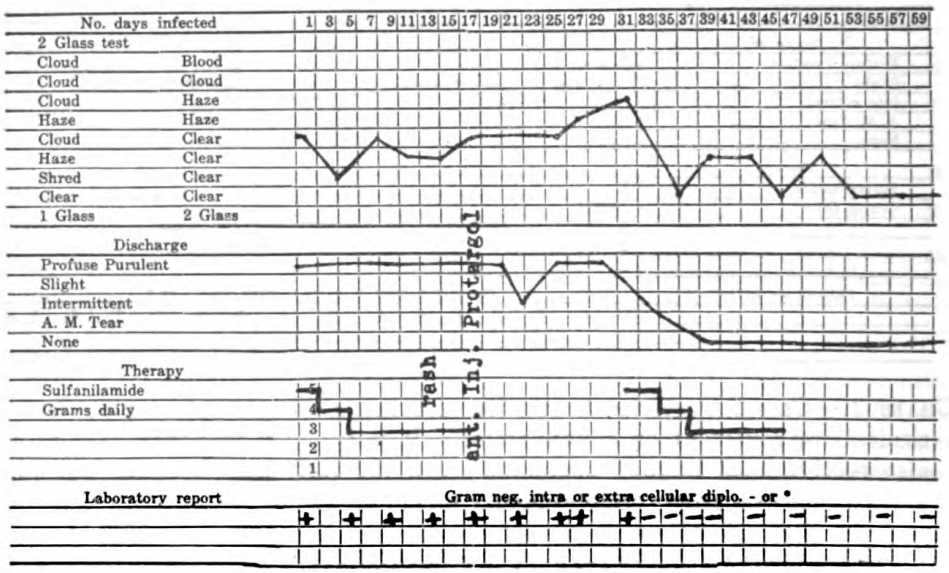


CHART 2.—Case 26, demonstrates the ineffectiveness of sulfanilamide on the course of the disease in this case during the first day 17- course of treatment. It also illustrates the prompt cure obtained by administration of a second course of therapy after some tissue immunity had developed.

In the interpretation of results of chemotherapy in gonorrhea it must be remembered this is essentially a self-limited disease with a low mortality. Cure is dependent on development of local and humoral immunity. The virulence of an infection has been considered a matter of the soil, not of the gonococcus and variations in host resistance results in a variable course or chronicity (124). While a marked difference has been noted in the sulfanilamide response of different types of pneumococcus (129) and strains of meningococcus (6), and gonococcus (95) the latter could not be confirmed (96) and resistance seemed related to duration of infection. Sulfanilamide therapy results in an increase in the bactericidal power of the blood against the gonococcus and this may well explain the lessened incidence of metastatic infections (185). That host immunity still determines cure is indicated by better response in reinfection cases, second course

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cases (chart 2), and chronic stationary cases. This therapy appears to uniformly effect some improvement as relief of burning, lessening of discharge, 2-glass test improvement, a greater percentage of prompt cures, fewer—by 50 percent (180)—complications or lessened severity of complications. These results seem to indicate a rather uniform support of the biologic response in controlling gonorrhea.

Individual failures continue to occur due to inefficient immune response. They emphasize the limitations of sulfanilamide but are no indictment of its use. The use of local therapy favors local tissue immunity and it should be continued. In the average case where self-administered it is preferable to delay until some degree of acuteness has subsided. This depends on host reaction rather than duration of infection. A case of several weeks duration may still present the creamy purulent discharge, pouting urethra, and numerous intracellular organisms typical of an acute infection. These drugs are not bactericidal and even in high dosage do not rid the body of organisms. There is accumulating evidence that smaller dosage is equally effective and larger amounts tend to increase the incidence of toxic reactions. Both experimental and clinical evidence in other infections indicates the drug prolongs life or hastens cure by an inhibitory effect, and that when discontinued, if immunity has not developed, a relapse occurs. Since this seems to hold true in gonorrhea it is believed the drug should be given in moderate dosage until cure is obtained. This is a slow and capricious process in gonorrhea, unlike the rapid course in pneumonia or erysipelas.

It is concluded these drugs have the following favorable action:

(1) They inhibit the growth of gonococci *in uitro*.
(2) Protect susceptible animals (mice).
(3) Increase the bactericidal power of the blood.
(4) Effect prompt cure in approximately one-third of acute anterior urethritis cases.
(5) Relieve the subjective symptoms in acute posterior urethritis.
(6) Permit the omission of local therapy during the early acute phase when unwise, energetic, or vigorous procedures so easily result in extension of infection or disabling complications.
(7) Lessen incidence of disabling complications.
(8) Shorten the course of disabling complications.
(9) Support host immunity in effecting earlier cure.

Toxic Reactions

These have been previously presented and Stout as well as others have adequately reviewed the subject (1) (190). It is important to differentiate between the purely toxic manifestations and the more serious idiosyncrasy reactions. The latter include agranulocytosis and

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acute hemolytic anemia and appear to occur only in individuals peculiarly sensitive to the drug much as in the case with amidopyrine or dinitrophenol. Bone marrow cell culture (64) and animal experiments show the drug has no direct toxic effect on cells (127). The purely toxic reactions are fairly common, related to dosage, not serious and subside rapidly on dosage reduction or drug withdrawal and sometimes even on continued administration.

The subjective symptoms are chiefly cerebral and occur in from 50 or 55 percent up to 70 percent of cases (169). Consisting of confusion, giddiness, lassitude, dullness, or sleepiness they are well tolerated and do not necessitate dosage reduction as used. Nerve parasthesia may occur (case 21), it persists for several weeks, disappears after drug withdrawal. A case with neuritis of arm and thorax is reported (128).

The objective evidences are more alarming.

Cyanosis is evidenced by slaty nail beds and occurs in up to 50 percent of cases (28). There were no severe occurrences in this group. These drugs are aniline derivatives and may lead to the formation of methemoglobin or sulphhemoglobin both of which are frequently found on spectroscopic study. However many cases show neither (132) (135) or if they are present the amounts are too small to account for the cyanosis which is frequently excessive in relation to the nonfunctional iron pigment present (132) (193). Much of this cyanosis has been attributed to some unidentified pigment but it can probably be explained by the fact that a 5 percent saturation of the blood with methemoglobin will suffice for the visual detection of cyanosis whereas much larger concentrations are required for observation and measurement of its absorption band. Since methemoglobin is very unstable and is destroyed rapidly an ordinary spectroscopic examination is uncertain when less than 25 percent of the blood pigment is present in this form (225). Extensive deposits of a greenish brown granular pigment have been noted in the spleens of treated rats (194). The formation of sulfhemoglobin in the presence of aniline derivatives has been attributed to functional intestinal disturbances as purgation which keeps the colon contents in a semifluid state favoring putrefaction and H_2S formation (133). This is prevented by giving liquid petrolatum, cleansing enemas, and a diet low in residue and eggs. Colebrook feels that large doses are no more liable to cause nonfunctional iron pigment than small ones and that length of treatment is unimportant (20). Since sulfhemoglobin is readily formed only in the presence of altered hemoglobin it is likely that the unstable methemoglobin favors its formation. The intravenous injection of 1 mg of methylene blue per kilogram of body weight actively accelerates the conversion of methemoglobin to hemoglobin (134). This may prove useful in an occasional case. Therapy should be given cautiously in

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anemia for the formation of nonfunctioning iron pigment may seriously aggravate the condition.

BLOOD CELLS.—There is no constant effect. Chen found that prolonged administration to rabbits produced no significant change in Hb., or red, white, or differential counts (127). It has no toxic effect on human bone marrow cells *in vitro* in concentrations of 1:1,000 or less (64). In humans no essential change was noted in the blood cells or Hb. except in infectious cases with a leukocytosis in which the WBC falls to normal and the Schilling hemogram appears consistent with clinical improvement (135) (136) (165). A mild reticulocyte increase occurs indicating bone marrow stimulation (136). Most of my cases showed one or two juvenile cells per count at some time during therapy. Eosinophilia of 3 to 10 percent occurred in 17 of the 44 cases. It has no bearing on prognosis.

NEUTROPENIA.—White blood counts were made on alternate days and the lowest count was 4,950. The average was 6,000–8,000. Case 32 possibly had early neutropenia.

Case 32.—After 5 days on sulfanilamide (total of 22 gm) he complained of "feeling feverish and having sweats." Temperature was 101° and throat was very red and edematous. The WBC was 5,900 with a normal differential. Drug was discontinued, patient put to bed, and fluids forced. The next day temperature was 104°, sweats continued, and WBC 5,000. The following day TPR normal, throat greatly improved, and the WBC gradually reached 8,000 during the next few days.

This patient may have had impending agranulocytosis, a gonococcemia or a concurrent throat involvement. Blood culture and bone marrow studies could not be obtained. Since angina is a rather late manifestation of agranulocytosis its presence hardly favors this diagnosis. Four weeks later he was given 32 gm of sulfanilamide in 8 days with no change in the WBC and cure of his gonorrhea.

Kracke maintains that drugs with a benzene ring and attached amine group, which increases the ease of oxidation, may cause agranulocytosis. Two such cases are reported from the Johns Hopkins Hospital with no deaths and a number of authors have reported neutropenia (155). There are several reported deaths from this cause (126). One case died on the fortieth day (40 gm) with a previous history of thrombopenic purpura (126a). In another case the neutropenia was first noted 4 days after the drug had been discontinued (total 54 gm)(126b). In one case the drug was continued for 3 days (total of 56.6 gm in 21 days) after the WBC reached 3,900 (126d). In a case that had been intolerant to two previous courses of 5 and 7 days each the third course of 11 days resulted in death (38 g) (126e). None of these fatal cases occurred immediately following the initial dose as is so often the case with aminopyrine. Usually the neutropenia began after 1 or 2 weeks of treatment and death occurred 2 to 3 days after onset. The leukocytes gradually decrease over a period of 2 or 3 days and the bone

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marrow shows a maturation arrest. There is apparently little danger if the drug is discontinued early and fluids are forced. It is essential to check the WBC at least every other day.

ANEMIA.—Eleven cases have been referred to (1). Other reports of 1 case (144), 3 cases (145), and 18 cases (155) have appeared and some authors indicate a milder type of anemia may result (112), (138). A maturation arrest with the bone marrow showing reduction in nucleated red blood cells and many degenerate forms is reported, though Long found the bone marrow normal and considered the toxic action to be on the circulating cells (155). A death is recorded on the thirteenth day of treatment in a patient who continued to receive the drug after becoming jaundiced on the second day (161).

CARDIAC.—A case of arrhythymia, possibly due to sulfanilamide ingestion, has been reported (199).

DERMATITIS.—This toxic reaction has been reviewed previously (1). It developed in four cases in this series at a time when each case was receiving a dosage in excess of 4 gm daily. Various reports indicate it occurs in approximately 10 percent of cases. Some workers consider it related to disturbed porphyrin metabolism for marked porphyrinuria has been noted in patients receiving sulfanilamide (194).

HEPATITIS.—Jaundice may occur but none was noted in this group (128) (215).

FEBRILE DISTURBANCES.—Three cases occured on the fifth, sixth, and ninth days. It is reported as occurring from the seventh to the tenth day in one of every six cases who received 1 gm per 20 pounds per day (28) and in 14.96 percent of cases (112). One case of fever and uncontrollable hiccough has been reported (181).

URINARY DISTURBANCES.—Albuminuria and hematuria may occur (128) and a case of acute nephritis has been reported (158). Case 42 developed hematuria (47 gm in 10 days) and case 39 developed pitting edema of the ankles and an abnormal dilution-concentration test with inability to concentrate above 1.017. The blood pressure remained normal and the concentrating ability of the kidneys returned to normal within a week.

ALIMENTARY DISTURBANCES.—These consist of gastric upsets and occasionally of diarrhea. None occurred in this series.

ELIXIR OF SULFANILAMIDE.—The deaths following the use of this preparation were due to the vehicle, a cumulative poison which induces fatal anuria (200). This experience hastened general recognition of the dangers of untried preparations and drug companies have become more willing to withhold the newer drugs awaiting further study (137).

MODE OF ACTION.—The important clinical consideration remains the restoration of the patient to health and a correct understanding of the mechanism by which this is effected will eliminate useless and unnecessary therapy, inconstant therapeutic results and will allow a

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greater exactness and success in therapeusis. Once the mechanism of action of sulfanilamide is known a vast impetus will be given toward all bacterial therapeusis. The experimental work reported to date fails to explain the exact mechanism of action but does indicate some of the effects to be expected and helps explain the clinical results.

Inhibition of bacterial growth *in vitro* by this drug has been noted by many investigators. With streptococci in small numbers (66), in 1:1,000 dilution (36) (64) (58) in 1:10,000 dilution (71), and in bone marrow tissue cell culture experiments in from 1:1,000 to 1:100,000 dilutions (64), provided, the infecting dose of bacteria remains within clinically encountered ranges. Using massive infections even a 1:100 concentration failed to protect thus corroborating previously observed massive infective-dose experiments in mice (64). This growth inhibition is effective only after 2 (71) or 4 (64) hours and in treated experimentally infected mice there is a several hour delay before the numbers of organisms are reduced as compared to controls (71). There is some evidence its early action may be stimulative for an accelerated multiplication of an 8-hour strain of streptococci seeded in fibrinated serum occurs during the first 4 hours (165). During the next 4 hours the growth curve presents an even more precipitous fall. The exposure of cultures of streptococci to sulfanilamide results in an appearance of sterility after 24 hours but if kept for 72 hours gross turbidity occurs demonstrating merely a temporary inhibition (64). The time of appearance of the gross turbidity seemed to be dependent on the concentration of sulfanilamide present. It has been frequently noted that treated mice may later die and be found free of organisms and lesions (59) (78) (83).

Change has been noted in drug exposed bacteria *in vitro* as compared to controls. Streptococci exposed to Prontosil, soluble, for some hours, washed, and injected subcutaneously in guinea pigs produced less reaction than did untreated washed cultures (59). Degenerative changes have been noted in nonphagocyted cocci (76), in extracellular meningococci in treated mice (60), and changes in size and metachromatic staining in streptococci in sulfanilamide serum (75). The streptococci from pleural exudates of treated cases show less predominately mucoid colonies in only the primary culture (75) and colony type is unchanged from treated mice (80). It is without effect on the dehydrogenases of type I pneumococcus (74) and slightly inhibits the oxidation of glucose by hemolytic streptococci and lactate by B. *friedlander* (79), which suggests interference with bacterial nutrition.

It has been noted that sulfanilamide is far more soluble in the fatty envelope of the streptococcus than it is in aqueous solution but the importance of this has not been determined (165). While interference with capsule formation by streptococci was thought to explain the

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drug action, it has been demonstrated the streptococcus does form capsules in defibrinated blood containing the drug as well as without it (19) (71) and capsule formation in treated mice is unchanged (80).

Variable results due to the species influence are shown in the inhibition of streptococci by serum from treated humans (66) (71) (80) and treated monkeys (8) but not from treated mice or rabbits (66). However mice develop practically no resistance to these organisms and individual differences in resistance are shown, at least in mice, by the inconstancy of controlled experimental results (59) (60). The spinal fluid from treated cases exerts a bacteriostatic effect against streptococci (74) and the urine (47) (49) against all common urinary tract invaders except streptococcus fecalis. In confirming this latter work it was noted the addition of urine to the initial media and diluent enhances the drug effect (46). It has been noted the addition of normal human serum will enhance drug effect. Furthermore the presence of tissue cells results in earlier inhibition than does serum and drug (64). Species differences are further shown by the fate of sulfanilamide in the body. In the dog it appears unchanged in the urine, while in the rat, rabbit, cat, and man varying amounts appear as the acetyl derivative which is practically inert therapeutically (15), is more toxic, and less soluble (127). Mice infected with the streptococcus and cured with sulfanilamide are not immune (77) (78) and agglutinins for streptococci are never demonstrated (36) (78). Mice that are treated and survive B. *typhosus* infections sometimes show agglutinins and some immunity (36).

It apparently does not influence the antistreptolysin curve in rheumatic fever (105a), suggesting no elimination of streptococci, since the titer in the serum of animals falls rapidly as soon as antigen injection is discontinued (105b), and guinea pigs maintain high titers when carrying foci of infection (105c). The hypersensitivity of guinea pigs tissues to hemolytic streptococci is uninfluenced (105a). As noted above, tissue cells and virulent streptococci may coexist for days merely by the addition of fresh sulfanilamide every 48 hours (64). On subculture the organisms retain all their virulence and ability to form toxins.

Any inactivation of preformed toxin by sulfanilamide could not be demonstrated (64a), (206). The exudate from sulfanilamide-treated, streptococcus-infected mice, remains fully virulent whether the cultures are sterile or not (71) (80) and the toxin features of scarlet fever are not influenced by drug therapy. Such evidence indicates a lack of antitoxic effect.

In an active infection (brucellosis) the serum acquires increased ability to stimulate phagocytosis and retains this property after all sulfanilamide has been excreted. This serum stimulates washed cells from untreated, uninfected humans or guinea pigs to increased phago-

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cytosis. The cells from treated cases when washed and placed in serum from controls do not possess this property nor can sulfanilamide in the absence of infection impart it to normal cells or render bacterial cultures *in vitro*, more susceptible (174). The lack of special attraction for leukocytes can also be demonstrated by droplet observation under the microscope (198).

From available evidence it seems the drug produces an environment, in the presence of infection, favorable for the increased production of opsonins. In mouse experiments with *C. welchii* the number of phagocyted bacteria decreases in the treated animals as the number of free bacteria decrease (80). In untreated animals the number of phagocyted bacteria increased with the increase of free bacteria. Similar results are obtained using streptococci in mice excepting that in untreated animals phagocytosis decreases when the infection becomes overwhelming and depresses or overpowers the leukocytes to the point where their phagocytic ability is lost. In these untreated animals an absolute as well as a relative decrease of phagocytosis occurs as the cellular-destructive forces progress. This cellular destruction either does not occur or is markedly delayed in the presence of sulfanilamide. In human bone marrow cell culture experiments, the addition of fresh sulfanilamide every 48 hours, reduced the inoculated virulent streptococci (normally capable of readily destroying the cells) to harmless saprophytes with cells and organisms surviving unchanged for days (64). Osburn considered the number of organisms present to be sufficient to destroy the cells in the absence of sulfanilamide.

It is apparent that some type of protective screening of the cells, against the noxious influences of the organisms, must take place. If these tissue culture cells are exposed to sulfanilamide up to 8 or 12 days they exhibit no change in their phagocytic ability. Thus the drug is neither toxic for the cells nor does it stimulate phagocytosis. This is in accord with numerous reports on animal experiments in which no stimulation of phagocytosis could be detected in treated animals. Furthermore there is adequate reason to believe the bacteriostatic effect of the drug is independent of the leukocytes (80) (165) though its effects are favorable to continued phagocytosis (75) (80) (191) (196). The leukocytes do, however, play an important part in ultimately ridding the body of organisms.

These results lack direct clinical application since the most virulent bacteria are used in sensitive animals, the invasive period is shortened by preliminary or early drug administration, different species react differently and the drug fate varies with species. However there is a similarity between the localization of infection in the peritoneal cavity (1), (41), (82) and subcutaneously in mice (55), and guinea pigs (84), in erysipelas as evidenced by the tendency for abscesses to form (34) (112), and by the lessened incidence of septicemia not only

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in mice (41) (55) (82), rabbits (75), and rats (191) but in the numerous clinical reports on various diseases as erysipelas, puerperal infection, pneumonia, etc., in which spread of infection is lessened. In patients treated for hemolytic streptococcic sore throat the throat cultures often remain positive after recovery (28) (29) (143), organisms persist in infected tonsils (105a) (143) following subsidence of the acute infection, and in puerperal fever cases the cervical cultures are positive after recovery (19). This persistence of organisms after clinical cure is also true of gonorrhea (see chart 3).

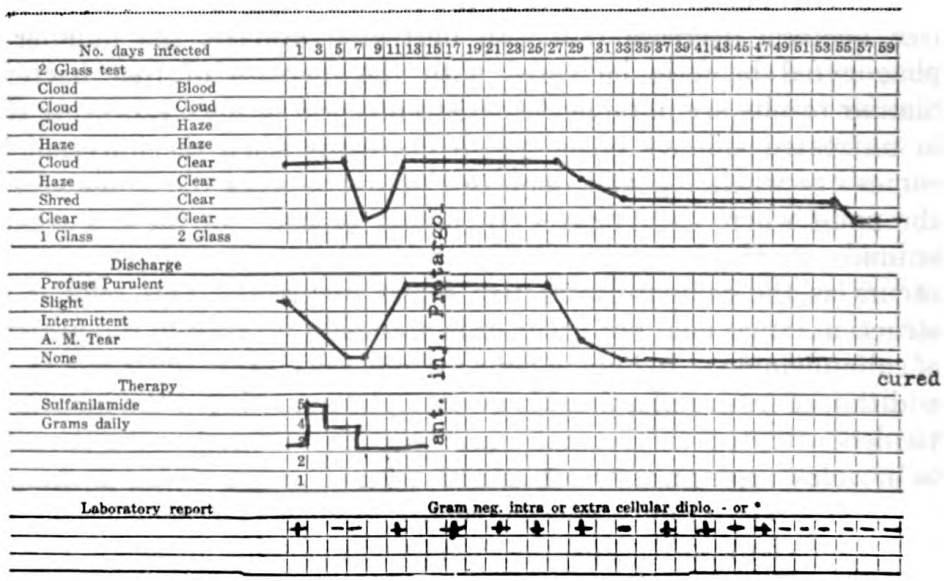


Chart 3.—Case #35. Simple anterior urethritis. Had this case been seen only on the fifth and sixth days for recheck it may well have been pronounced cured. Note the relapse on the eighth day for no apparent reason.

There is no direct destructive action in the sense of the usual antibacterial germicide, rather an inhibition of multiplication—a bacteriostasis with limitation of invasive qualities and apparently some controlling influence which protects against the cellular destructive action of bacteria. These effects are not striking but apparently sufficient to allow dramatic clinical results. It does not in itself rid the body of organisms and unless immunity is developed relapses occur. The host lacking resistance to the invading organism (mice-streptococci) and capable of developing little or no immunity, eventually succumbs in spite of drug therapy. In humans where tissue immunity is capricious or develops slowly (gonorrhea) relapses are prone to occur. If the infection is overwhelming or body defenses are exhausted little effect need be expected.

Recapitulation

Inhibition of bacterial division occurs *in vitro* and *in vivo*. This effect is enhanced by serum and tissue cells. Degenerative changes

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in organisms are inconstant and do not influence virulence or toxin production on even the first subculture. The toxins remain but seem incapable, in the presence of sulfanilamide, of destroying cells except in infections more massive than those encountered clinically. The type of cellular response remains dependent on host; is not in itself drug conditioned. Phagocytosis is enhanced indirectly through bacteriostasis but is not related to drug action on body cells, although opsonin production appears to be hastened under drug altered conditions. Host supremacy is ultimately dependent on biologic response to the invader. The drug seems to inhibit the multiplication and spread of bacteria and protects cells from the destructive influences of infective organisms, thereby inducing a more favorable environment for opsonin production and the action of other host protective mechanisms.

Dosage. Sulfanilamide (base) is soluble in water 0.4-0.8 percent and can be given subcutaneously. It is so rapidly and completely absorbed from the gastro-intestinal tract (120) that diarrhea does not influence the absorption (118). After oral administration the maximum blood level is reached in about 4 hours (120) and animal experiments indicate that in therapeutic dosage the blood level is directly proportional to the dose (127). The tissue distribution is dependent on water content, bone and fat containing the drug in lesser concentrations (17). Thus oral administration is preferable except in the unconscious, stuporous, or vomiting patient. The initial dosage should be high, to quickly establish an effective concentration.

A blood level of 10 mg-percent has proven adequate. The optimum dosage for this attainment will vary with individual absorption and excretion rates and with diuresis. It lies near 15 to 20 grains four times daily. An initial dosage of 1 grain per 20 pounds of body weight per day reduced to three-fourths this amount after 2 days and one-half after the first week has proven a satisfactory schedule in children (110). Colebrook has used up to 15 grams daily in cases with severe puerperal infection (20) and Long considers large doses essential (80). A greater incidence of toxic reactions has been noted with a continued dosage of 1 gram per 20 pounds of body weight per day, and personal experience confirms this in any dosage above 4 grams daily (28).

Concentrations of 1:100,000 have proven as effective as 1:1,000 in tissue cultures (64) and 5 to 10 gr. q. 4h proved effective clinically against *beta*-hemolytic streptococcus infections (64a). In the average case a blood level of 7 mg-percent (130) or 6 to 7 mg-percent (182) proved effective. The latter was obtained on 6 grams the first day and 3 grams daily thereafter. In treating children with *beta*-hemolytic streptococcus complications of middle ear and mastoid disease, an initial daily dose of 0.6 gm per 20 pounds of body weight was used and 0.06 gm per pound per day (4–6 doses) for maintenance (99).

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This maintained a blood concentration of 10 to 15 mg-percent. Apparently children tolerate proportionately larger doses than adults. The successful treatment of erysipelas with 10 gr. t. i. d. and urinary infections with 10 gr. q. 4h indicate smaller dosage may suffice (87). In treating gonorrhea many cases have been found to respond with blood concentrations much lower than 7 mg-percent and resistant cases were frequently unresponsive even to much higher concentrations (182).

In the human a certain portion of sulfanilamide is acetylated at an unknown site (118). The blood content of the acetylated product is low as compared to the free form. It is excreted by glomerular filtration, appearing in the urine in 3 to 4 hours after ingestion. From 70 to 90 percent of the free sulfanilamide is reabsorbed through the tubules so it continues to appear in the urine for 24 to 48 hours after a single dose. The therapeutically inactive (15) conjugated form is apparently reabsorbed less readily by the tubular epthelium and is present in the urine in much higher concentration than is the free form (118). The renal clearance, independent of plasma level, is increased by diuresis so this assumes an important role in therapy of toxic reactions (118). Since it is excreted almost entirely by the kidneys it must be given carefully in the aged and others who have, or may have, decreased renal function. However, renal disease is no contraindication (47a). In the lactating woman free sulfanilamide is excreted in the milk (220) in concentrations closely corresponding to the values present in the blood stream (221). There is some evidence that the free and combined sulfanilamide level in the milk is higher than the blood level (213). However a nursing baby cannot obtain an adequate therapeutic dose through the milk of a mother who receives only an average clinical dose (221) and there is no apparent danger of toxicity (214). Appreciable amounts of the drug appear in the perspiration especially in hot weather when there is profuse sweating and small urine volume (222).

After routine oral administration the drug diffuses into the cerebrospinal fluid in at least 80 percent of the blood concentration so its intrathecal use in meningitis therapy is probably unnecessary. Furthermore, since it is the organisms in the blood vessels and the inflammatory tissue frontiers which are responsible for spread it seems more logical to reach those via the general circulation and experimental results indicate that oral administration is satisfactory (191). However, Eldahl considers intrathecal therapy essential for, "with the inflammatory changes incident to meningitis the normal diffusion of the drug may be interfered with" (117). He gives 5 to 30 cc of 0.8 percent solution, but always less than the amount of spinal fluid withdrawn.

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The simultaneous administration of sodium bicarbonate is indicated and widely practiced because patients receiving sulfanilamide excrete an alkaline urine and lose bicarbonates and base with a tendency to develop symptoms of acidosis. Furthermore, an alkaline urine enhances the therapeutic effect against the usual urinary tract infections (47).

The drug is only 0.8 percent soluble at room temperature and 1.1 percent at body temperature (121). The acetylated derivative is even less soluble (118) (127). Consequently it is important to provide adequate urinary volume, especially with large dosage, to prevent crystallization in the renal tubules and urinary tract (118). Good urinary volume remains important also because of the value of frequent urinary flushing for infections of the urethra. Since urine retention favors epididymitis it is to be avoided.

Sulfanilamide acts by enhancement of body immunity consequently it is important to restrict those factors which retard immunity development (124). In gonorrhea therefore, sex, alcohol, and sexual excitment should continue to be forbidden. As immunity in gonorrhea develops slowly it is probably important to continue the drug for several weeks rather than to expect a 10-day cure. The large doses appear unnecessary and are more toxic. They need be given not longer than 1 week during which time about 10 percent of cases will be promptly cured. A smaller dosage can be continued for several weeks while tissue and humoral immunity develop. As the drug is an adjunct to and not a replacement for immune reactions it remains important to administer immune sera and antitoxin therapy when available.

It is a neutropenic agent, occasionally producing agranulocytosis in susceptible individuals. In all patients who have died from this the onset was after the fourteenth day. It has not yet been proven that a shorter period of administration is safe and therefore all cases should be checked with a WBC at least every other day. It seems clear that the onset of agranulocytosis in these cases is gradual, over a period of 2 or 3 days, and that in at least some of the fatal cases the drug was continued even after a low count was obtained. In any case where the WBC drops to 6,000 a blood count should be done every day or even more often and as indicated by case 32 and proven by the more extensive experiences at Johns Hopkins if the drug is discontinued in these cases deaths do not occur and heroic therapy is usually not indicated.

Artifically induced fever is of great value in the treatment of gonorrheal complications but the complex technique, cost, and danger preclude its routine or general use (104). It should be reserved for special cases and used only under competent supervision.

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The drug should be administered cautiously in anemic patients because of the danger of adding nonfunctional iron pigment and in renal disease because of slow excretion.

Conclusion

The drugs of this group are not cure-alls and their use as such will only lead to condemnation. They possess a definite effect and are a valuable adjunct to established therapy but their limitations must be recognized. When properly used they are reasonably safe but it is apparently necessary to obtain frequent white blood cell counts during therapy to be forewarned of impending neutropenia. The continued synthesis and trial of new compounds promises to extend their use and it remains for future study to establish the exact status of these agents.

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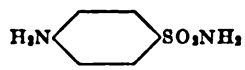
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THE PHARMACOLOGY OF SULFANILAMIDE[1]

By Pharmacist PAUL S. GAULT, United States Navy

The increasing use of sulfanilamide throughout the naval service in the treatment of many diseases, its widespread use in many conditions such as streptococcal, pneumococcal, and gonococcal infections and now recently in chancroidal ulcers, is ground for the belief that the service would be interested in knowing something of the chemistry of this compound.

Sulfanilamide, *para*-aminobenzene-sulfonamide,



is a white, crystalline powder, practically odorless and possessing a slightly bitter taste, with sweet after taste. It is slightly soluble in water, approximately 0.9 parts in 100 passing into solution at 20–25° C., and in solution has a pH of about 8.4.

There are three possible isomers of this compound, the *ortho-*, *meta-*, and *para*-aminobenzene-sulfonamides. The only one which is recognized by the Council on Pharmacy and Chemistry of the Ameri-

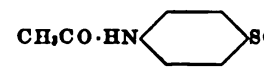
[1] From the laboratories of the Navy Medical School.

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can Medical Association is the *para* compound, designated as sulfanilamide.

Many derivatives of sulfanilamide were investigated by Fourneau [2] and his coworkers [3] of the Pasteur Institute in Paris. They showed that it is the position of the different substituents which is responsible for the action of this compound. Mietzsch and Klarer [4] demonstrated that by shifting the SO_2NH_2 group from the *para* to the *ortho* or *meta* positions inactive compounds were formed which did not have the chemotherapeutic action of the *para* compound. It would seem therefore, if, in the commercial preparation of this compound, fractions of either the *ortho* or *meta* isomers were formed along with the *para* compound, that therapeutic action would be lessened in proportion to the amount of the *ortho* or *meta* isomers present. This might possibly explain why some brands of sulfanilamide are at times thought not to have the expected chemotherapeutic action. Unfortunately there seems to be no simple definite chemical test which will distinguish the *ortho*, *meta* and *para* compounds from one another. Their melting points show sufficient variation for tentative identification; the *para* compound melts at 165–166° C., the *ortho* at 152–153° C., and the *meta* at 142° C. But in order to apply this physical test these compounds must of necessity be in a very pure state. This becomes an involved procedure when dealing with compressed tablets containing such added inert constituents as sugar, acacia and talc.

After administration of sulfanilamide to patients it is rapidly diffused through all body tissues and is found in the blood and urine in two distinctly different forms, free and conjugated. The latter, as found by Marshall [5] consists mainly, if not entirely, of the acetylated derivative, *para*-acetyl-aminobenzene-sulfonamide,



It has been proved that the acetylated form possesses no chemotherapeutic activity [6].

Our findings indicate that the free form (sulfanilamide) comprises approximately 90 percent of the total compound found in the blood and 50 percent of that found in the urine of individuals under treatment. The amount of the acetylated form in the blood is negligible, whereas of the total sulfanilamide present in the urine the acetylated form comprises about 50 percent. From a clinical standpoint the determination of the conjugated (acetylated) form in the blood is of

[2] Fourneau, E.: Comt. Rend. Soc. Biol., 120 (1935).
[3] Trefouel, E., Nitti, F., and Bovet, D.: Ibid. 122 (1936).
[4] Mietzsch & Klarer: As stated by Addinall, C. R., Merck's Report.
[5] Marshall, E. K., Jr., Cutting, W. C., and Emerson, K., Jr.: Science, 85: 202, (1937).
[6] Rosenthal, S. M.: Public Health Rep., January 8, 1937.

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no practical value due to the negligible amount found and its relative chemotherapeutic inactivity. On the other hand, if the total amount of the drug excreted in the urine is desired, a determination of the free sulfanilamide would only represent 50 percent of the total drug present in the urine. To obtain a true value of the total sulfanilamide excreted in the urine it is necessary to convert the acetylated form to free sulfanilamide by hydrolysis (decomposing by the action of HCl and heat). The total free sulfanilamide is then determined.

In estimating free sulfanilamide in blood the proteins are first removed by precipitation with trichloracetic acid. The clear, protein-free blood filtrate is diazotized with sodium nitrite in the presence of acid, the acidity from the trichloracetic acid employed being sufficient for this reaction. This diazotized compound is then coupled with dimethyl-*alpha*-naphthalamine producing a red azo dye which is estimated colorimetrically against a known sulfanilamide standard similarly treated. The color produced by this reaction is not permanent, and with weak solutions of sulfanilamide it is slow in forming. This tardy reaction and tendency to fade is occasioned by the fact, as recently reported by Marshall [7], that the excess nitrous acid, in the presence of sodium chloride, inhibits the reaction and destroys some of the azo dye formed. Marshall employs a solution of ammonium sulfamate (an amine salt of sulfuric acid recently developed by E. I. Dupont & Co.) buffered with sodium dihydrogen phosphate which destroys the excess nitrous acid. After this treatment he couples the diazo compound as usual with dimethyl-*alpha*-naphthalamine. By this method more rapid color development and more permanent colors are obtained. This change in technique has been found to be very satisfactory. Copies of this revised procedure may be obtained from the Naval Medical School on official request.

GONORRHEA TREATED WITH SULFANILAMIDE

By Commander MAURICE S. MATHIS, Medical Corps, United States Navy, and Lt. (Jr. Gr.) PHILIP J. McNAMARA, Medical Corps, United States Navy

A study was made by the staff of the department of urology at the naval hospital, Washington, D. C., of the first 100 consecutive admissions of gonorrhea, acute, chronic, with and without complications, which were treated with sulfanilamide.

At the time this work was undertaken, much information was appearing in the literature regarding the efficiency of sulfanilamide in gonococcal infections. The opportunity was presented to hospitalize and to study, under close medical supervision, all patients in this area with gonorrhea in its usual manifestations and complications. It was

[7] Marshall, E. K., Jr., Litchfield, J. T., Jr.: Science, 88: July 22, 1938.

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felt that some considerable information could be obtained by the careful tabulation of pertinent laboratory and clinical findings.

If sulfanilamide therapy in gonorrhea, and its complications, can reduce the total days on the sick list due to this disease, the man-power days that could be restored to active duty per year would be a considerable factor. A large series of controlled observations seemed necessary in order to arrive at any definite understanding. Many of our cases were hospitalized for a longer than necessary length of time because we wished to watch for recurrences. Hence, we are unable, in this series, to give any data on hospital days necessary per case.

The successful use of sulfanilamide in gonococcal infections has been widely heralded in literature of all kinds. Everyone is now acquainted with the splendid work of the pioneers in this field of chemotherapeutics, both in this country and abroad. Much has been discussed concerning the pharmacology and physiology of sulfanilamide. The methods of administration and experimental dosages have been reported varyingly and confusingly.

In this paper no effort is made to evolve a needless repetition of a comprehensive review of the literature on sulfanilamide. The seemingly epoch-making work of original investigators here and abroad is now well known to most of the profession. Reports of the successful use of sulfanilamide in gonococcal infections have been made by numerous reputable clinics. It is our purpose merely to present the facts obtained in 100 nonselected cases of gonorrhea, and its complications, which have received sulfanilamide therapy.

TABLE I.—*Cases classified*

Diagnoses	*Number of cases*
Anterior urethritis	28
Anterior and posterior urethritis with prostatitis	31
Posterior urethritis and prostatitis	13
Anterior and posterior urethritis with prostatitis and epididymitis	19
Anterior urethritis and periurethral abscess	2
Anterior and posterior urethritis with arthritis	1
Posterior urethritis with prostatitis and epididymitis	2
Anterior urethritis with stricture of urethra	1
Anterior urethritis with prostatitis and stricture of urethra	1
Anterior and posterior urethritis with prostatitis and arthritis	2
Total	100

Table I shows the types of gonococcal infections treated in this series. Acute and chornic cases were treated the same. No attempt was made to classify them separately. These diagnoses represent, in their respective groups, the admission diagnosis plus the diagnoses of the complications developing under treatment.

It will be noted that only 28 patients, who were originally admitted with diagnosis of anterior urethritis, were carried through on that single diagnosis. The remainder of the patients either were admitted

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with complications already existing, or developed them while under treatment. Most of our admissions were from adjacent shore stations and ships which were not equipped to hospitalize or adequately treat gonococcal complications. This latter fact accounts for the large number of complications on admission diagnoses.

TABLE II.—*Schedule of sulfanilamide dosage*

	Grains		Grains
First day	60	Seventh day	80
Second day	80	Eighth day	80
Third day	120	Ninth day	60
Fourth day	120	Tenth day	60
Fifth day	120	Eleventh day	60
Sixth day	80	Daily thereafter	40

Table II shows the dosage of sulfanilamide used by us in the last 50 cases in our series. We experimented with several different dosages and finally decided upon the above schedule. Our purpose in using the comparatively heavy dosage was to arrive at a schedule which would definitely keep the blood sulfanilamide level up to a point between 10 to 15 mg- percent for a period of 3 to 4 days. Because of apparent individual idiosyncrasies to the drug, it was decided to reach the heavy dosage gradually over a period of 3 days.

Daily dosages were administered in six divided portions. Divided daily dosages were given every 4 hours in an effort to keep the blood sulfanilamide level constant. For example, patients receiving 120 grains daily, would receive 20 grains every 4 hours throughout the 24 hours.

TABLE III.—*Method of study*

1. Complete medical history on admission.
2. Complete physical examination and weight on admission.
3. Complete blood examination on admission.
4. Complete urinalysis on admission.
5. Kahn and Wassermann on admission.
6. Bacteriological study of secretions.
7. Bed rest until the sixth day. Diet regular.
8. Constant daily medical supervision.
9. Temperature, pulse, and respiration every 4 hours.
10. Blood sulfanilamide determination twice weekly.
11. Complete blood count twice weekly.
12. Urine sulfanilamide determinations daily on 24-hour specimens during first portion of the series.
13. Warning to prevent use of magnesium sulphate for purgation.
14. Warning to stop administration of drug whenever temperature of patient rises above 102° F.
15. Ten grains of soda bicarbonate given every 4 hours with each dosage of sulfanilamide.
16. Fluids to 2,000 cc daily.
17. P. R. N. CO_2 combining power determinations.

Table III shows the method used to control the patients in this series. By strict adherence to the above routine we were able to prevent

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the development of serious reactions and were able to keep patients under close supervision.

TABLE IV.—*Criteria for cure*

1. Absence of urethral discharge.
2. Urine clear in 3-glass test for at least 1 week.
3. Absence of the signs or symptoms either present on admission or developed under treatment.
4. Prostatic secretion microscopically within the limits of normal on repeated examinations.
5. Failure of demonstration of gonococci in Gram stain of prostatic secretion on repeated examinations.
6. Failure of flare up after passages of sounds.
7. No recurrence for at least 1 month.

Table VI shows the criteria used for discharge from the hospital, apparently well. All of our series finally met the above requirements before they were allowed to go back to duty but it will be seen that in a large number of cases, supplemented therapy was necessary.

TABLE V.—*Criteria for classification as failures*

1. Failure of cessation of urethral discharge within 14 days.
2. Failure of disappearance of gonococci from prostatic secretion in 14 to 21 days.
3. Failure of improvement or disappearance of symptoms of acute prostratitis or epididymitis within 14 days.
4. Development of any progression or complication of gonorrhea while under sulfanilamide therapy.
5. Development of any toxic symptoms which necessitated withdrawal of the drug before an improvement could be noticed.
6. Recurrence.

Table V shows the criteria used for designation of failure or unimprovement while on sulfanilamide therapy. No other treatment was used in this series until a classification of success or failure was made. We considered that 14 to 21 days of unsupplemented sulfanilamide therapy constituted a fair trial with this drug. When a classification of failure was made, we treated the resistant cases by the usual methods employed by urologists before the advent of sulfanilamide.

TABLE VI.—*Criteria for classification as successes*

1. Only sulfanilamide therapy used.
2. Cessation of urethral discharge within 14 days.
3. No gonococci present in prostatic secretion at the end of 14 to 21 days.
4. No progression or development of any complication of gonorrhea while under sulfanilamide therapy.
5. No development of toxic symptoms necessitating withdrawal of drug before improvement was noticed.
6. Ability to comply with all the other requirements listed in table IV.

Table VI shows the criteria used for the designation of success due to sulfanilamide therapy alone. Any case failing to conform to requirements listed in table VI or failing to finally fulfill all the

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requirements in table IV, were classified as failures on sulfanilamide therapy alone.

Undoubtedly many of our classified failures were definitely benefited by the drug and needed but a very small amount of supplementary treatment either in the form of anterior urethral installations or prostatic massages with deep irrigations. In many cases, the supplementary treatment resulted in a rapid disappearance of all signs and symptoms and a rapidly successful completion of the criteria for discharge to duty, apparently well, such as listed in table IV.

We feel that sulfanilamide played a definitely helpful role in these cases which received supplementary treatment. Nevertheless we cannot classify these cases as having been cured by sulfanilamide alone since they failed to complete our requirements as set forth in table VI.

TABLE VII.—*Results*

	Cases	Successes	Failures
Sulfanilamide therapy alone	63	30	33
Sulfanilamide therapy plus a minimum of supplemented treatment	37	37	None
Sulfanilamide therapy with and without supplemented treatment		67	33

Table VII shows 63 cases of this series in which sulfanilamide therapy alone was used. Of this number only 30 were completely cured. There were 33 classified as failures because they fell under the criteria for failure as listed in table V. The 33 failures were so marked in the manner of progression, complications developing under treatment, recurrence, inability to tolerate the drug, and continued resistance to drug therapy, that by no criteria could they be classified otherwise than as failures. It will be noted that there were 37 cases in which sulfanilamide therapy was used plus a minimum of supplementary treatment.

An example of minimal supplementary treatment was a case of anterior and posterior urethritis with moderate prostatitis and a positive urethral discharge which failed to fulfill the requirements for success on sulfanilamide therapy alone. After 14 days of sulfanilamide therapy followed by two or three prostatic massages and deep irrigations, this case was able to fulfill all the requirements for complete cure and was discharged to duty 1 week later. It would be hard to believe that sulfanilamide did not play a very definite role in the successful cure of this case.

The third item of this table shows what may fairly be considered our success with sulfanilamide therapy when the above explanations are taken into consideration—30 complete cures with sulfanilamide alone in less than 14 days; 21 cessations of urethral discharge in less than 14 days which were finally well on a minimum of supplementary treatment; 16 cases of prostatitis and epididymitis without a discharge

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which cleared up either with or without a minimum of supplementary treatment, total up to 67 cases which may be classified as being successful on sulfanilamide therapy.

Only 51 cases of this series had a complete cessation of urethral discharge in from 1 to 14, average 7, days. Although one of our criteria for cure was completed, we were able to find, in all but 30 cases, positive evidence to prove that the remaining men were not completely cured on sulfanilamide therapy alone. These latter 21 cases, all cleared up with from 1 to 2 weeks of supplemented treatment.

TABLE VIII.—*Blood sulfanilamide levels*

	Milligrams percent
Average level on fifth day	11. 0
Average level from third to seventh day	9. 73
Single extreme high level of entire series on fifth day	18. 3
Single extreme low level of entire series on fifth day	5. 3

Table VIII shows the average blood sulfanilamide concentrations as determined when, according to the intake of the drug, the highest levels should be obtained. Before we settled on the dosage as shown in table II, we experimented with several combinations or schedules recommended by various authorities. In these cases our average high blood sulfanilamide concentration on the third to fifth day was 7.4 mg-percent. We were using dosages comparable to a schedule of 80 grains daily for the first 3 days, 60 grains daily for the second 3 days, and 40 grains daily thereafter. Our results were definitely better when we obtained blood sulfanilamide concentrations of from 9.0 to 12.0 mg-percent. However, we shall point out later that there were many cases which did not seem to benefit on blood sulfanilamide levels ranging up to 12.5 mg-percent.

TABLE IX.—*Progressions or complications developing under sulfanilamide therapy*

Series No.	Blood sulfanilamide high level	Days on drug	Complications, progressions, or recurrence
3	5.7	17	Prostatitis.
6	7.9	32	Periurethral abscess.
10	9.1	28	Prostatitis.
17	6.3	29	Prostatitis, epididymitis, and recurrence.
21	8.3	28	Prostatitis.
29	8.2	20	Do.
34	8.3	25	Periurethral abscess.
36	4.5	24	Prostatitis, epididymitis, and recurrence.
38	9.0	25	Prostatitis.
43	5.8	18	Arthritis.
49	6.8	30	Do.
55	6.8	15	Epididymitis and recurrence.
59	10.7	46	Epididymitis, prostatitis, periurethral abscess, and recurrence.
63	7.9	68	Prostatitis and recurrence.
64	9.1	82	Do.
66	8.6	50	Prostatitis and epididymitis.
68	5.3	54	Prostatitis.
70	7.5	30	Prostatic abscess.
74	11.5	60	Prostatitis and stricture of urethra.
75	12.5	38	Prostatitis.
78	7.1	48	Prostatitis and arthritis.
85	7.5	45	Prostatitis.

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Table IX shows 22 cases of progressions, complications, and recurrences of the disease while under sulfanilamide therapy. The above listed cases are progressions and complications which developed while the blood sulfanilamide level varied from 5.3 to 12.5 mg-percent. The days on the drug in this group ranged from 15 to 82. Eleven other cases showed only stubborn resistance to the drug after a long trial. These above cases comprise our 33 failures listed in table VII.

Short outlines will be found below of a few cases illustrating complications and progressions of gonorrhea while receiving sulfanilamide therapy.

Case Reports

Case 78 was admitted June 29, 1938, with a urethral discharge of 2 days' duration. No previous venereal disease. Treatment was started June 30, 1938. Blood sulfanilamide level reached 7.1 mg-percent 3 days later. Nineteen days later there was only a moderate decrease in the discharge. It was considered that he had had a fair trial of drug therapy, so supplementary treatment was started in the form of anterior urethral injections of 5 cc of ¼ percent protargol twice daily. Two-glass tests showed both glasses cloudy with pus and shreds. A gentle prostatic examination showed the prostate to be acutely involved. Three days later (the twenty-fourth day of sulfanilamide therapy) he developed an acute arthritis of the right wrist which was considered to be gonococcal in origin. Sulfanilamide was increased to 80 grains daily and daily deep irrigations were started with 1–10,000 potassium permanganate. Immobilization, followed by physiotherapy, hydrotherapy, and general supportive measures were used in addition to drug therapy. Sulfanilamide was discontinued after 48 days of continuous administration. The only toxic manifestation of the drug was the development of a moderate secondary anemia with drop in hemoglobin from 90 to 67 percent and a corresponding fall in red blood cells. Three months' hospitalization was necessary and finally gradual improvement was obtained with prostatic massages and deep irrigations after the acute symptoms had subsided.

Case 34 was admitted August 31, 1937, with uncomplicated acute urethritis, with a urethral discharge of 1 day's duration. On the seventeenth day of sulfanilamide, a periurethral abscess developed which subsided well with local treatment. The highest blood sulfanilamide level was 8.3 mg-percent. Sulfanilamide therapy was given for 25 days.

Case 59 was admitted January 8, 1938, with uncomplicated acute urethritis, with urethral discharge of 3 days' duration. He received sulfanilamide therapy for 29 days. On the sixteenth day, an acute prostatitis developed. The urethral discharge continued positive. He finally apparently cleared up with supplementary treatment and went to duty with only a mild residual prostatitis. One month later he returned with a recurrence of urethral discharge and a unilateral epididymitis. Sulfanilamide therapy for 16 days more resulted in complete subsidence except for a mild residual prostatitis. This case showed a marked resistance to sulfanilamide therapy with progression on the first admission and a recurrence. On the second admission the results obtained with sulfanilamide were very satisfactory. The highest blood sulfanilamide level on the first admission was 10.7-mg percent. The highest blood sulfanilamide level on the second admission was 10.3 mg-percent.

Case 49 was admitted December 1, 1937, with a flare-up of a chronic prostatitis and a scanty urethral discharge. He received sulfanilamide therapy for 30 days. The highest blood sulfanilamide level was 10.7 mg-percent. Very little progress

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was obtained and supplementary treatment was started after 18 days of drug therapy. An acute arthritis with typical signs and symptoms developed in the right knee after 25 days of drug therapy. The duration and course of the arthritis did not seem to be altered by stepping up the dosage of the sulfanilamide. Recovery was finally completed after a long convalescence.

Case 6 was admitted August 18, 1937, with urethral discharge of 3 days' duration. No history of any venereal disease. Sulfanilamide therapy started August 19, 1937. Maximum concentration of blood sulfanilamide was 7.9 mg-percent. Eleven days later the drug was stopped because of mild toxic symptoms but resumed again in 4 days. On the twenty-first day of drug therapy, a periurethral abscess developed 1 inch from the external orifice of urethra. Meanwhile very little cessation in the amount of discharge had been noticed. The abscess was incised on the twenty-eighth day of drug therapy and with supplemented local treatment there was an uneventful recovery.

TABLE X.—*Mild toxic symptoms*

1. Headache.
2. Lassitude.
3. Weakness.
4. General malaise.
5. Anorexia.
6. Drowsiness.
7. Cyanosis.
8. Mental dullness.
9. Loss of weight.
10. Constipation.
11. Nausea.
12. Dizziness.

Table X shows the usual mild toxic manifestations which may be rather directly attributed to the use of sulfanilamide. These are usually present in more or less degree in all patients with a blood sulfanilamide level of above 5.0 mg-percent. Individual variations of degress of toxic manifestation may be very wide. Because of close medical supervision no one of the above toxic symptoms caused us undue alarm or necessitated withdrawal of the drug.

TABLE XI.—*Moderate toxic symptoms*

Symptoms or signs	*Occurrences*
Acidosis (CO_2 combining power 38 to 45 volumes percent)	6
Acute febrile reaction (temperature from 102.5° to 105° F.)	12
Severe generalized urticaria	2
Erythematous maculopapular skin eruption	6
Edema of lower extremities	1
Tender hyperemic subcutaneous nodules of lower extremities	1
Vague paresthesias of lower extremities	4
Acute schizophrenic breakdown	1
Secondary anemia (average loss of hemoglobin 20 percent, range from 10 to 30 percent)	41
Abdominal pain	3

Table XI shows the moderately toxic symptoms in this series as they occurred in 54 of our patients. Any one of these toxic symptoms may demand a serious consideration for immediate withdrawal of the drug. Our experiences in this series were as follows:

Acute febrile reactions necessitated withdrawal of the drug, giving fluids to 5,000 cc daily, continuance of administration of soda bicar-

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bonate, soda bicarbonate enemata, and general supportive measures. A temperature drop to normal within 36 to 48 hours was obtained unless some progression of the disease or intervening infection was present.

Severe urticaria usually disappeared within 36 hours on withdrawal of the drug.

Erythematous maculopapular skin eruptions were generalized or localized to the exposed skin. These skin eruptions usually disappeared within 36 to 48 hours after withdrawal of the drug and forcing fluids.

Our cases of edema of the lower extremities and vague paresthesias cleared up shortly after the withdrawal of the drug.

Our cases of abdominal pain simulated many acute abdominal conditions and necessitated surgical consultations. Subsequent operative findings in two of our cases made us wonder if the toxic effect of sulfanilamide were a contributing factor in flaring up what was possibly chronic cholecystitis and an interval appendix. However these conditions may have been only coincidental.

One case of an acute schizophrenic break, necessitating psychopathic institutionalization, may have been precipitated by the mental confusion which is frequently observed as a mild toxic symptom. The pre-psychotic personality make up of this case was very fertile ground and the break may have been only coincidental.

Secondary anemia, ranging from 10 to 30 percent, with an average of 20 percent loss of hemoglobin, was seen in 41 of our cases. Iron compounds in large dosages were used to combat this condition.

Short outlines may be found below of a few cases of the most interesting moderately toxic reactions to sulfanilamide.

Case Reports of Reactions

Case 14 was that of a recurrent urethritis with left epididymitis. Sulfanilamide therapy was started January 8, 1938. At the end of 3 days his temperature had gradually elevated to 102.5° F. The blood sulfanilamide concentration was 11.1 mg-percent. He appeared moderately cyanotic, acidotic, and mentally confused. The urethral discharge had ceased in the first 24 hours and the epididymitis appeared to be rapidly subsiding. Sulfanilamide was discontinued and in 48 hours his temperature was normal and the toxic symptoms had subsided. Two subsequent attempts to administer sulfanilamide resulted in the same train of toxic events. The results were so satisfactory in this case, and in several others of acute febrile reactions, that we began to feel that the combination of chemotherapy and fever caused rapid improvement in these cases, especially when the temperature elevation went as high as 105° F.

Case 81 was admitted July 4, 1938, with profuse purulent urethral discharge for the duration of the previous week. He received sulfanilamide therapy for 8 days with complete cessation of urethral discharge on the fifth day. On the eighth day his temperature was elevated to 101° F. He appeared cyanotic, weak, had a loss of appetite and slept most of the time. The next morning he rapidly developed a generalized erythematous maculopapular skin eruption with edema of the face,

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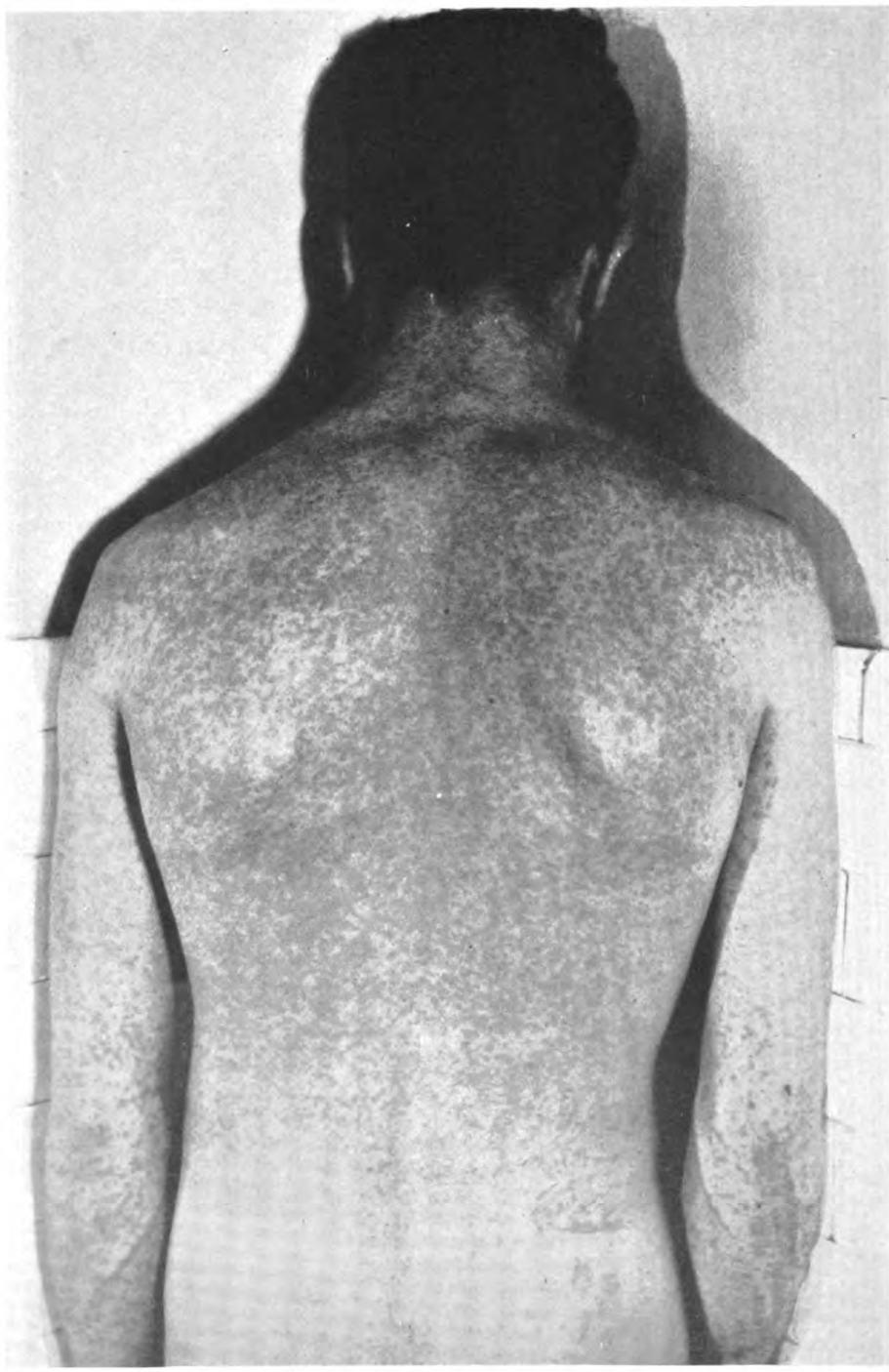


FIGURE 1.—SULFANILAMIDE SKIN REACTION.

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especially the lips and eyelids, and a circumoral pallor (fig. 1). His blood sulfanilamide level was 6.5 mg-percent. Temperature was 101° F., pulse 90, respiration 18; RBC, 3,620,000; hgb., 10.5 gm or 68 percent.; WBC, 5,600 with 5 percent eosinophils. He had no other complaint or symptom of any intercurrent disease. His general physical examination was essentially negative except for the skin eruptions which developed into large hyperemic confluent patches on the trunk but remained diffusely maculopapular on the extremities. Sulfanilamide was discontinued and fluids were forced. In 36 hours all evidence of the eruption had disappeared.

TABLE XII.—*Severe toxic symptoms*

1. Agranulocytosis.
2. Acute hemolytic anemia.
3. Peripheral neuritis.
4. Optic neuritis.
5. Nitritoid crisis.

Table XII is inserted in this paper merely to state that none of these severe toxic symptoms were observed in our series, but they have been reported by other investigators.

CONCLUSIONS

1. Rather large dosages of sulfanilamide were necessary to maintain the blood sulfanilamide level above 10 mg-per 100 cc of blood.

2. Close medical supervision should be maintained on all patients receiving sulfanilamide. The heavy dosage schedule in table II is not recommended for ambulatory out-patients.

3. The criteria listed in table IV, table V, and table VI may be augmented or varied. However, these criteria were considered to be the most practical at this stage of our study.

4. It may be pointed out that only 30 percent of our series showed definite cure on sulfanilamide therapy alone; however, we feel justified in including, for our total of successes, the additional 37 percent which were rapidly improved by a minimum of supplementary local treatment. It may be proven, in another series, that the best treatment for gonorrhea will be a combination of chemotherapy and local treatment, using much less heavy dosages of sulfanilamide.

5. The necessity of raising the blood sulfanilamide levels to 11.0 mg-percent, or above, is as yet unproven. We feel that our results have been better in those cases in which the blood sulfanilamide level was maintained in the vicinity of 10.0 mg-percent for 3 to 4 days.

6. Twenty-two percent of our cases showed either definite progressions or developed severe complications while under sulfanilamide therapy. The blood sulfanilamide concentrations were relatively high in most of these cases. We believe that a high blood sulfanilamide concentration does not prevent the development of progressions and complications of gonorrhea.

7. Mild toxic symptoms as listed in table X should not be disregarded. A progression of any single one or combination of any

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of these so-called mild toxic symptoms may be sufficient cause for discontinuing the drug.

8. Toxic symptoms developing from sulfanilamide therapy should be treated according to the merits of the individual case. Since individual variations and idiosyncrasies have been noted, it is not wise to administer sulfanilamide without close medical supervision.

9. Occurrences of moderately toxic symptoms in 54 cases are listed in table XI. This is either a very high incidence of toxicity or we have been too conservative in our estimations. The explanation may be found either in the severity of the disease or in the size of the dosage. Many of these cases needed no discontinuance of the drug but were treated symptomatically. Many of the moderately toxic symptoms were listed before it was discovered that they might be prevented by the administration of 10 grains of soda bicarbonate every 4 hours with each divided daily dosage of sulfanilamide.

10. After withdrawal of the drug, forcing fluids, and symptomatic treatment, only one of the cases of moderate toxic symptoms failed to show a rapid reduction in toxic symptoms and a satisfactory return to normal condition. The above exception is the case of the schizophrenic breakdown which has shown but little improvement since the occurrence 1 year ago.

11. Previous studies on blood sulfanilamide levels at intervals during the day and night, and quantitative sulfanilamide determinations on 24-hour urine specimens, showed that the administration of the divided daily dosage every 4 hours would best maintain a constant blood sulfanilamide level.

12. The severe toxic symptoms as listed in table XII are of sufficiently grave importance that they must be kept in mind if sulfanilamide therapy is contemplated.

13. It is fair to assume that sulfanilamide or some related compound, either used alone, or in combination with standard local treatment, is the treatment of choice for gonorrhea. Further studies are necessary to determine the exact role of sulfanilamide in the treatment of gonorrhea.

TREATMENT OF GONOCOCCAL INFECTIONS WITH SULFANILAMIDE[1]

By Lt. (Jr. Gr.) ANTON ZIKMUND, Medical Corps, United States Navy

Fifty cases of various types of gonococcal infections, but chiefly acute anterior urethritis, were treated with sulfanilamide according to Colston's plan while hospitalized during the acute stages of their infection and then carefully checked at their respective battalion sick bays until expiration of the remainder of the course of treatment.

[1] From the regimental hospital, fourth regiment U. S. Marines, Shanghai, China.

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On admission a mimeographed sheet calling for a daily tabulation of all pertinent data was attached to each patient's clinical record. These data consisted of a daily urethral or intraurethral smear depending upon the amount of discharge present, description of the amount and character of the discharge, intake and output of fluids, complete blood count on alternate days, daily urinalysis, and a record of daily treatment rendered. In addition, 3-glass tests were done as indicated to check the progress of treatment. Approximately 30 cases were managed in this manner, and thereafter repeated urinalysis and blood counts were omitted because of lack of clinical significance of the findings in the first group of cases when collectively evaluated.

However, in those cases either not responding well to treatment or exhibiting signs of idiosyncrasy to the drug, urinalysis and completed blood counts were done frequently. In this manner, a systematized standard method of management obtained in each individual case.

Treatment

All patients were treated according to Colston's plan with no local therapy except in those individual cases showing little or no response within a reasonable length of time as indicated in the accompanying tables. Fluids were limited as closely as possible to 2,000 cc daily.

The plan of treatment used was as follows:

20 grains 4 times a day for first 2 days.
15 grains 4 times a day during next 3 days.
10 grains 4 times a day during next 5 days.

In the last 25 cases, the treatment was modified in that the 10-grain dose was given for 9 days instead of 5 days and treatment was continued for an additional 2 weeks with 5 grains four times a day.

In most of the cases classed as failures, protargol ¼ percent b. i. d., anterior installations, or other suitable treatment was added to the sulfanilamide régime after a reasonable length of time because of limited hospital accommodations. In this group of cases, local treatment either alone or in conjunction with the sulfanilamide sufficed in most instances to eventually effect a cure.

Clinical Findings

Blood picture.—Routine total erythrocyte, leucocyte, hemoglobin, and differential counts done on alternate days on the first 25 patients revealed no significant deviations from the normal limits, and for this reason and due to limited laboratory facilities, this procedure was discontinued thereafter except in individual instances discussed under reactions.

The almost constant finding of pallor was not associated with any decrease in either total erythrocyte count or hemoglobin estimation.

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URINALYSIS.—With the exceptions of the two instances of albuminuria (two plus and one plus respectively), nothing of pathological significance was associated with any of the patients undergoing treatment. A 3-glass test was done on all patients on admission to help in determining the site of infection, and also at selected intervals thereafter to follow the progress of the case.

SMEARS.—Smears were done daily during the duration of the acute manifestations and thereafter intra-urethrally at suitable intervals. From 6 to 8 weeks following cessation of discharge, a prostatic examination was done on all cases and a Gram's stain made of the prostatic secretion for evidence of organisms and pus cells to conclude study of the case.

Those cases responding to treatment indicated the progress being made by, first, a change in the morphology of the organisms which lost their well-defined coffee-bean outline and secondly by a tendency of the organisms to become Gram positive just before disappearing completely in the succeeding smears. This latter characteristic was repeatedly observed in cases several weeks old showing little or no response to treatment. Although not considered definitely Gram positive, they also were not totally negative to Gram's stain as seen in early smears made before instituting sulfanilamide therapy.

DISCHARGE.—With few exceptions, the earliest changes noted in the discharge were a marked decrease in amount and a change from cloudy to a thin and watery type. In a few cases, particularly those requiring more than 10 days to subside, the cessation of discharge was surprisingly sudden.

In a majority of the failures, an early (second to third day) notable decrease in amount of discharge occurred only to become profuse again in the succeeding days.

COMPLICATIONS.—Acute prostatitis complicated four cases, occurring on the nineteenth day, sixteenth day, twelfth day, and ninth day of treatment respectively. The latter two cases developed additional complications of phlebitis of dorsal vein of the penis and left inguinal adenitis, and acute levolateral epididymitis respectively. No treatment other than sulfanilamide tablets orally was given in these four cases.

Other complications were noted in this series of patients, but since they occurred after local treatment was instituted in addition to the sulfanilamide, they have not been considered in this paper as related to sulfanilamide alone.

REACTIONS.—Practically all patients complained either of a dull generalized headache or a sense of pressure persisting for several days in the head until the smaller doses were taken, as well as a feeling of

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languor and sluggishness. A large proportion of the patients also appeared somewhat pale and pasty although the complexion could not correctly be called cyanotic or anemic. There were only two instances of marked reaction.

The first patient's discharge stopped completely within 5 days under sulfanilamide but on the tenth day of continued therapy he suffered a reaction characterized by fever, 104.6°, extreme malaise, dizziness, and cyanosis of the fingers and mucous membranes. Within 2 days, the total erythrocyte count dropped to 3,520,000; hgb to 70 percent, total leucocyte count 6,320 with the following differential: Segs, 38 percent; bands, 12 percent; lymphs, 50 percent. The urine showed two plus albumin. There was no rash or other findings of note. A discharge, positive for gonococcal organisms, reappeared on the third day of the reaction. The patient was up and about in 1 week with a normal temperature and pulse, and returned to duty in 2 weeks with cessation of the discharge under protargol instillations. The urine cleared up in 1 week, and the blood picture returned to normal limits in 4 weeks. Thus, following immediate discontinuation of the drug and with general supportive treatment the patient's convalescence was uneventful and complete within 3 weeks.

The second case complained of nausea, anorexia, and marked malaise on the fifth day of treatment. The discharge stopped completely on the day of onset of the reaction. Noteworthy physical findings included a temperature of 101°, pulse 94, cyanosis of the nails and mucous membranes and ashen pallor, pronounced asthenia and depression. The total red cells count was 4,800,000; hgb. 90 percent, total white cell count 6,500, and a normal differential count. The urine was negative. Recovery was complete within 8 days. Two weeks later this patient was readmitted to the hospital with recurrence of a positive urethral discharge, which responded to local therapy within 10 days.

As this paper was being written, a third severe reaction was experienced in a case not included in this series. This patient stopped discharging on the third day of treatment, and on the sixth day developed marked weakness, anorexia, nausea, severe throbbing headache, and pain in the eyeballs and ears. Cyanosis of the nails was pronounced. A temperature of 104.8°, pulse 120, albumin one plus, total erythrocyte count of 4,820,000, hgb. 90 percent, completed the remaining prominent findings. Prompt discontinuation of the drug and palliative treatment sufficed in 5 days to restore the patient's condition to normal. On the eighth day he also suffered a recurrence of discharge positive for gonococcal organisms.

An isolated instance of joint reaction was experienced in a patient admitted with acute anterior urethritis and a previous venereal history of gonorrhea with several recurrences of acute discharge and two hospital admissions with epididymitis. The findings aside from acute tenderness of the right metacarpal bones, were purely subjective; and on discontinuation of the drug the complaint disappeared within 2 days.

Summary of Results

A total of 50 patients were placed on sulfanilamide. Of this number, 37 were cases of acute anterior urethritis (2 of this number were subacute in degree), 8 of subacute anterior and chronic posterior urethritis, and the remaining 5 were miscellaneous instances of some complication of gonococcus infection necessitating active treatment.

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Tabulated results

Type of infection	Total number of cases	Cures		Failures	
		Number	Percent	Number	Percent
Acute anterior urethritis	37	18	48.6	19	51.4
Subacute anterior and chronic posterior urethritis	8	5	63	3	37
Miscellaneous (gonococcal complications)	5	1	20	4	80

ACUTE ANTERIOR URETHRITIS.—In 13 of the 18 cases responding completely to sulfanilamide, complete cessation of discharge was effected within the first week of treatment so that the prognosis in each case could be predicted with a fair degree of certainty within the first week of treatment. Many of these cures took place within 2 to 3 days.

SUBACUTE ANTERIOR AND CHRONIC POSTERIOR URETHRITIS.—A total of eight cases of this type were given a month's treatment with sulfanilamide and additional deep permanganate irrigations following cessation of the anterior urethritis.

In this group of cases as in the proceeding series, favorable results were characterized by a cessation of discharge and negative urethral smear within 2 to 4 days. In three of the five cures, 1 to 2 months' time under local therapy were required to clear up the posterior infection following cessation of the anterior symptoms. These patients carried on their regular duties during the latter interval and were pronounced cured only after sounds were passed without producing a recurrence of symptoms and after obtaining negative smears of the prostatic secretion. In the other two cures no treatment other than sulfanilamide was used.

MISCELLANEOUS.—The remaining five cases comprise a heterogenous group of complications of gonorrhea with a positive urethral discharge. Most interesting of this group was a case of chronic posterior urethritis and prostatitis with arthritic involvement of the right knee and left wrist. Treatment for 1 month with sulfanilamide—40 gr four times daily in addition to local measures brought about a complete recession of swelling, pain, and tenderness in the joints involved as well as complete recovery from the urethral involvement. The remaining four cases, each complicated by prostatitis, showed no response whatever.

Finally, it is worthy of note to mention that this treatment of approximately 50 cases of gonococcal infection occurred during the active performance of duty associated with heavy work required in the construction of sandbag dugouts, etc. As laboratory facilities at this time were necessarily curtailed, accurate clinical data relative to a diagnosis are not available in this series of cases. However, a cessa-

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tion of urethral discharge was enthusiastically reported by a large percentage of the patients so treated.

Conclusions

1. Sulfanilamide is a very useful drug in the treatment of both acute and chronic gonococcal infections.
2. Favorable results are usually attained quickly—within 2 to 6 days; failure to respond early indicates strongly that little or no improvement will follow thereafter despite continuation of this drug.
3. Use of sulfanilamide is not without danger from idiosyncrasy. Destruction of erythrocytes associated with cyanosis has been the most important clinical finding. However, prompt discontinuation of the drug has been sufficient to ensure convalescence rapidly.
4. Complications have been experienced with sulfanilamide therapy just as they have occurred with other methods of treatment.
5. Use of sulfanilamide may be recommended in all cases of gonococcal infection for several days, and use discontinued after the first week if the results are not satisfactory.

SULFANILAMIDE IN THE TREATMENT OF GONORRHEA ABOARD SHIP

By Lt. Comd. C. A. Young, Medical Corps, United States Navy, and Lt. J. H. Ward, Jr., Medical Corps, United States Navy

This report briefly reviews 35 consecutive cases of gonococcus infection which have been treated with sulfanilamide aboard the U. S. S. *Wright* during the past year.

Diagnosis was established by history, symptoms, and by the presence of the typical Gram-negative intra- and extra-cellular diplococcus. Criterion of cure was as follows: Disappearance of the discharge and the gonococcus, absence of the gonococcus in repeated specimens of urine (stained smear of the urinary sediment), and freedom from any signs of urinary tract involvement over a period of 2 months following the disappearance of the discharge and the gonococcus, i. e., absence of shreds from urine and three consecutive negative prostatic smears taken at weekly intervals.

Prior to instituting treatment, each case was examined thoroughly. Particular attention was given to the red blood count, hemoglobin, white blood count and differential, and complete and microscopic study of the urine. These laboratory studies were checked every third day.

The patients were advised as to the possibility of reactions to the drug and were daily examined and questioned as to signs of toxicity which might accompany the use of sulfanilamide; namely, lassitude or fatigue, dizziness, dyspnea, skin rashes, cyanosis, headache, fever, etc.

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Treatment

Sulfanilamide was given by one of the following three methods listed:

(1) 20 gr. q. i. d. for 2 days; 15 gr. q. i. d. for 3 days; 10 gr. q. i. d. for 8 days.
(2) 20 gr. q. i. d. for 5 days.
(3) 10 gr. q. i. d. for 2 days; 15 gr. q. i. d. for 3 days; 20 gr. q. i. d. for 8 days.

Sodium bicarbonate, gr. 15, was given with each dose of sulfanilamide to counteract, if possible, the acidosis which investigators have found to accompany, in a greater or lesser degree, the administration of sulfanilamide. Other than sodium bicarbonate, no other medications of any sort were given.

The number of cases treated by the above methods were about equally divided.

It might be noted that the patients reported to the sick bay four times daily to receive each dose of sulfanilamide. The drug was not given to them in wholesale amounts, trusting to their discretion to take the proper amount at the proper time.

The sulfanilamide used in this series came from four manufacturers. Some apparent difference was noted in the results obtained from these different products. One preparation was seemingly less effectual than the other three. Among the cases of acute gonorrhea, primarily infected, our records show a high percentage of failures that occurred almost consecutively. These cases were treated almost exclusively by a single brand of the drug. Whether these failures can be attributed to an ineffectual drug or to that unexplainable factor, individual variation, cannot be determined at present.

Clinical Results

(1) In each of the three different methods of administration, the amount of the drug was apparently adequate and no differences were noted in either untoward reactions or cure.

(2) When cure resulted, cases responded promptly by a completed and permanent disappearance of the gonococcus and the discharge in 2 to 7 days. In none of these cases that responded by cure to sulfanilamide were there any complications such as prostatitis, epididymitis, vesiculitis, etc.

(3) Of the 35 cases treated, 20 responded by cure (57 percent cure): (*a*) Of 13 acute cases, never previously infected, only 2 responded by cure (15 percent cure); (*b*) of 14 acute cases, repeaters (those who at some previous time had had gonorrhea) 12 responded promptly (86 percent cure); (*c*) of eight chronic infections (chronic urethritis, prostatitis, or vesiculitis) 6 responded promptly (77 percent cure).

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(4) In four cases that failed to respond to sulfanilamide, the course was repeated within 4 to 8 weeks with equally poor results.

(5) In those cases that failed to respond to sulfanilamide, complications to the gonococcus were as prevalent as is usually seen during treatment by the old and tried methods.

(6) Symptoms of toxicity as noted by fever, headache, cyanosis, lassitude, fatigue, and shortness of breath appeared in but 54 percent of the cases and were usually mild, disappearing on either reducing or discontinuing the drug. There was no relationship between signs of toxicity and cure or vice versa. In only two cases (one of high fever, weakness, and cyanosis, the other very marked cyanosis) was it deemed necessary to discontinue the drug. In both of these cases the symptoms rapidly cleared on discontinuing the drug and forcing fluids. On attempting to use the drug again, the symptoms reappeared, so it was permanently discontinued. Cure by sulfanilamide was not effected in either case.

(7) In no instance was the blood picture appreciably altered.

Conclusions

It is realized that this is an extremely small series from which to draw any definite conclusions and those herein enumerated will undoubtedly not entirely agree with the final composite picture. Nevertheless from the results obtained in these cases, it might at present be inferred that:

(1) Sulfanilamide is useful in treating either chronic cases of gonorrhea or acute gonorrheal infections which occur in those previously so infected and should be used with a reasonable expectancy of a rapid cure in the majority of these cases.

(2) Few severe cases of toxicity from sulfanilamide will be encountered and if they do occur, should rapidly respond to discontinuance of the drug and forcing fluids. However, the possibility of the occurrence of serious accidents should constantly be kept in mind and watched for by frequent checks on the patient himself and equally frequent blood studies.

(3) Sulfanilamide, 20 gr. q. i. d. for 5 days gives quite as satisfactory results as much higher dosages in either ascending or descending amounts.

IMMUNE TRANSFUSIONS IN LYMPHOGRANULOMA INGUINALE[1]

By Lt. Comdr. John P. Brady, Medical Corps, United States Navy

All naval medical officers who have served in the Tropics or on board ships visiting tropical and subtropical ports have had the opportunity of observing and treating tropical bubo now called lymphogranuloma inguinale.

[1] From the U. S. Naval Hospital, Canacao, P. I. Submitted for publication October 1, 1938.

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We have appreciated for years the fact that this disease is venereal in nature. It is characterized by a rather definite incubation period, a primary lesion, glandular adenopathy, daily elevation of temperature lasting 6 weeks or more, sweats, loss of weight, marked weakness, and anorrhexia.

The clinical course is well known and we have been pathetically at a loss to find drugs or treatment that would alter the course very much. Anything that offers hope in the therapy of these cases should be indeed welcome.

With this in mind the medical officers on the urological service at the naval hospital, Canacao, began the use of blood transfusions. The donors were patients who had recovered from lymphogranuloma inguinale. As far as could be ascertained this method of treatment had not been used previously.

Technique

The method consists simply in direct blood transfusions from an immune donor.

The donor must have had the disease and recovered from it. The Frei test of course must be positive. No donor was used who has had the disease less than 10 weeks. Naturally syphilis or other conditions contraindicating transfusion must not be present and the recipient must be of the same blood type and the two bloods must cross match.

A transfusion is given of 250–300 cc of whole blood by the direct method.

In the majority of cases the recipient experiences a chill or chilly sensation in about 2 to 3 hours, this is usually followed by a temperature rise of 1° to 3°.

At the onset of the work those treated by this method were advanced cases running daily high temperature elevations but later, after observing the effect in these, transfusions were used in early cases when obtainable.

Case Reports

Case 1.—R. H. T., seaman, first class, admitted to the hospital March 13, 1937. Diagnosis undetermined (lymphogranuloma inguinale).

Chief complaint: Swelling and pain in right groin.

Present illness: This patient first noticed swelling in right groin 3 weeks ago. Swelling gradually became larger until 1 week ago when patient noticed pain in the region of the swelling. Has had daily marked elevations of temperature, sweats, and gradual loss of weight of about 10 pounds. Repeated venereal exposure in Manila admitted.

Past history: Irrelevant.

Family history: Irrelevant.

Physical examination: Patient is a well-developed young adult white male, not acutely ill. Has obviously lost about 10 or 15 pounds in weight.

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Genitalia: There is a swelling in the right groin consisting of lymph glands which are typical of lymphogranuloma inguinale The skin over the lateral aspect of this bubo is red and tender. This area is not fluctuant. On the penis there are several small excoriations of the mucous membrane of the prepuce with a slight watery discharge. Mild edema and slight erythema of the preputial mucous membrane. Testes and epididymides are normal.

Head: Negative.

Eyes: Pupils are dilated, react to light and in accommodation.

Ears: Negative.

Nose: Negative.

Mouth: Teeth in good condition. Tongue and pharynx normal. Tonsils removed.

Neck: Negative.

Chest: Expansion good and equal.

Lungs: Negative.

Heart: PMI in fifth ICS well within MCL, no thrills, no murmurs. BP 110/70.

Abdomen: Negative.

Extremities: Negative.

Progress notes: On admission—heat applied to inguinal region; placed on high caloric diet; Frei test made.

March 15, 1937: Kahn—negative. Patient runs daily afternoon temperature of 102°, force fluids, ice cap to head. Frei test positive. Urine—essentially negative. Diagnosis lymphogranuloma inguinale established.

March 25, 1937: Glands have become larger. No area of fluctuation. Daily temperature rise to 103°. Receiving supportive treatment.

March 27, 1937: Blood type—"0."

March 30, 1937: Patient has continued to run daily temperature elevations. Immune transfusion of 300 cc of whole blood given from immune donor. Transfusion was followed by chilly sensation and elevation of temperature.

April 2, 1937: Temperature considerably lower, daily elevations to 100°. Patient feels better and has regained his appetite.

April 3, 1937: Bubo smaller in size still no fluctuation. Heat continued locally.

April 8, 1937: Patient is gaining in weight; still runs a temperature of 100°. There is fluctuation present. Incision and drainage. Moderate amount of pus obtained. Culture made.

April 10, 1937: Culture shows no growth.

April 20, 1937: TPR normal, still has moderate amount of drainage.

April 30, 1937: Wound granulating. Patient up and about.

May 10, 1937: Kahn—negative. Receiving alpine-light therapy to wound, granulating slowly. Patient feels well.

May 13, 1937: Kahn—negative.

May 26, 1937: RBC—4,480,000. Hgb.—90 percent. No complaints.

May 27, 1937: Kahn—negative.

May 30, 1937: Wound granulating slowly.

June 5, 1937: TPR normal for last 6 weeks. Wound is completely healed. Discharged to duty.

The foregoing case represents the results obtained where the disease is fairly well advanced upon admission. The following represents one which was discovered and treated early.

Case 9.—W. W. W., pharmacist's mate, third class, admitted to the hospital April 8, 1938. Diagnosis, lymphogranuloma inguinale.

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Chief complaint: Painful swelling right groin.

Present illness: Patient first noticed pain and swelling in the right groin 8 days before admission. Repeated exposures admitted. Reported to ward medical officer and Frei test was made. Test was reported positive and patient was kept under observation. Two days before admission patient began to run a temperature elevation of 102° in the afternoon and the glands became considerably larger. Has lost no weight. Patient admitted to sick list for treatment.

Past history: Irrelevant.

Family history: Irrelevant.

Physical examination: Patient is a well nourished, 24-year-old male, does not appear acutely ill.

Genitalia: Examination reveals a lemon-sized mass of confluent, firm glands in the right inguinal region; moderate tenderness is present, no apparent fluctuation and no involvement of the skin. Glands otherwise negative. No penile lesion noted. There was present however, a mild erythma of preputial mucous membrane.

Eyes, ears, nose, and throat negative.

Chest: Expansion good and equal. Resonance normal.

Heart: No thrills, murmurs, or enlargement noted; BP 118/80.

Physical examination is otherwise essentially negative.

Progress notes: Patient admitted to bed, no local treatment. Temperature, 101°.

April 9, 1938: Patient given transfusion of 250 cc of whole blood from immune donor. Two hours following transfusion patient experienced a chill and elevation of temperature to 101.4°.

April 10, 1938: Lymphogranuloma mass is smaller. Temperature 100°. Patient feels better.

April 12, 1938: TPR have been normal for 2 days. Mass much smaller and is not painful. Patient discharged to duty under observation. Kahn—negative.

Follow-up note. April 18, 1938: TPR normal. Glands still smaller.

May 1, 1938: Patient has lost no weight during illness, has no complaints.

September 15, 1938: Glands are completely fibrosed. Patient has been doing regular duty since discharge on May 12, 1938. Frei test strongly positive, has given two immune transfusions, one in August and one in September with excellent results.

A series of 16 lymphogranuloma cases were given 20 transfusions from donors who were recovered cases of lymphogranuloma inguinale. The enclosed table was compiled from their records:

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Case	Date admitted	Duration of disease before transfusion (weeks)	Number of transfusions	Weeks in hospital	Additional treatment	Results
1. R. H. T., Sea. 1c	Mar. 13, 1937	6	1	9	Incision, drainage	Chilly sensations, elevation of temperature, followed by normal temperature curve. Course shortened, loss of weight stopped.
2. C. H. L., Pvt.	Apr. 15, 1937	4 and 8	2	14	do	First transfusion no effect. Second transfusion caused chill with elevation of temperature followed by a flattening of the temperature curve. Stopped loss of weight and caused diminution in size of glands.
3. C. M. P., B. M. 1c	Aug. 31, 1937	12	1	13	do	Chills, elevation of temperature for 2 days followed by normal temperature curve. Patient convalescent and stopped loss of weight.
4. W. F. S., F. 1c	Nov. 17, 1937	9	1	14	Incision, drainage. Antileutic theraphy.	No reaction, temporary rise in temperature of 2½° followed by flat temperature curve. Diminution in size of glands.
5. M. A. P., Sea. 2c	Dec. 13, 1937	5	1	11	Incision, drainage	Chills, increase in temperature followed by fall to nearly normal. Diminution in size of glands. Stopped loss of weight.
6. P. B., Sea. 2c	Mar. 25, 1938	3	1	12	Incision, drainage. Antimalaria theraphy.	No reaction from transfusion, stopped loss of weight.
7. F. P., Sea. 1c	Apr. 1, 1938	5	1	8	Incision, drainage	Chill, elevation of temperature followed by nearly normal temperature curve. Stopped loss of weight, shortened course, diminution in size of glands.
8. P. T., Pfc	Apr. 7, 1938	9	1	11	do	No chill, elevation of temperature 2½° followed by normal temperature. Diminution in size of glands.
9. W. W. W., Phm. 3c	Apr. 8, 1938	2	1	1	None	Chill, rise of temperature followed by normal temperature curve. Marked diminution in size of glands. Recovery with fibrosis of the glands without interference.
10. J. F. W., Pvt	Apr. 28, 1938	3 and 6	2	9	Incision, drainage	Chill, rise of temperature following first transfusion. No change in size of glands. Secondary elevation of temperature 5 days later. Relieved by incision and drainage. Second transfusion caused no chill but elevation of temperature followed by normal temperature curve. Diminution in size of glands. Hastened convalescence and stopped loss of weight.
11. W. W. W., Sea. 2c	May 16, 1938	1 and 2	2	10	do	Chilly sensation, increase in temperature from 101° to 104°, followed by daily rise to 102°. Second transfusion 1 week later caused no chill; temperature rise of 2° followed by normal temperature curve. Obese patient lost no weight, shortened course.
12. J. R. T., Pvt	June 7, 1938	4 and 5	2	3	None	No chill or temperature elevation. Marked diminution in size and rapid fibrosis of glands. No loss in weight.
13. A. R. B., Pvt	June 10, 1938	4	1	11	Excision bilateral inguinal nodes. Transfusion given 2 weeks after excision.	Chill following transfusion. Rapid healing of incisions. Gain in weight. Reduction of temperature to normal. Operative wound healed by secondary intention.

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Case	Date admitted	Duration of disease before transfusion (weeks)	Number of transfusions	Weeks in hospital	Additional treatment	Results
14. R. B. R., Phm. 3c	June 13, 1938	2	1	3	Excision bilateral inguinal nodes.	Operation and transfusion same day. Chill followed by elevation of temperature to 101°. Reduction of temperature to normal on third post-operative day. Primary union of operative incisions.
15. S. A. G., Sea. 2c	June 27, 1938	5	1	4	Excision left inguinal nodes.	No chill, reduction of temperature to normal with subsequent secondary rise of temperature of 4 days. Temperature normal thereafter. Wound healed by secondary intention.
16. C. B. S., Lt. (jr. gr.)	July 27, 1938	2 days	1	1	do	Chill following transfusion with reduction of temperature to normal. Primary union of operative incision.

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Summary

1. Eleven of these cases experienced a chill from 2 to 4 hours after transfusion.

2. The temperature curve showed elevation of 1° to 3° followed by flattening out to a level much below previous curve. Clinical improvement as evidenced by improvement in mental attitude, color, and appetite followed by a definite increase in weight was noted in all cases.

3. Only four cases required two transfusions.

4. In four cases excision was done. Two healed by primary union, with 9 days and 3 weeks respectively on the sick list. Two healed by secondary intention with 4 weeks and 11 weeks, respectively, on the sick list.

Conclusion

1. Of 16 cases of lymphogranuloma inguinale given transfusions from immune donors all showed distinct clinical improvement.

2. Lymphogranuloma inguinale may be a disease in which immunity is acquired with formation of immune bodies in the blood stream.

3. Immune transfusion is a therapeutic agent worthy of further special investigation with particular reference to verification of these observations.

4. A study of the possibilities of use of the blood bank is indicated if the above conclusions are verified.

5. The naval service offers an excellent opportunity for this study both because of the prevalence of the disease and the number of donors obtainable.

TREATMENT OF SCABIES [1]

By Capt. G. E. Thomas, Medical Corps, United States Navy

Scabies is a condition which continually confronts the medical department of this station. Newly enlisted men reporting from the recruiting stations for duty, men who return from training furlough, and men who while on liberty are exposed to scabies from their associations, are the most frequent sources of infection.

Prior to March 1, 1938, scabies patients were treated by segregation, hot bath with green soap and scrub brush, then applying sulphur ointment once daily for 3 days. On the fourth day they received a hot bath, and their bed clothing and underclothing sterilized and they were returned to duty. Sulphur ointment was objectionable to the patients. It caused a dermatitis in several instances; it has an unpleasant odor and uncomfortable in feeling; the pajamas, sheets,

[1] From the Naval Training Station, San Diego, Calif.

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pillow cases, etc., become stained, which the laundry is unable to remove.

On March 1 it was decided to use the benzyl benzoate treatment. This treatment* consists of, first a hot bath with green soap, using a rough wash rag. The patient then dries himself thoroughly and the benzyl benzoate preparation is applied to his body by means of a paint brush. This application is allowed to dry thoroughly and a second application given. The following morning the patient is given a hot bath and puts on clean underclothes. His pajamas, bed clothes, and clothing are sterilized to prevent reinfection. The advantages of this treatment are—It is odorless, does not cause dermatitis, is not unpleasant to the individual, does not stain the pajamas, sheets, or furniture, and enables the patient to return to duty in 2 days or less.

The formula is:

Benzyl benzoate 50 gm.
Liniment of soft soap 65 gm.
Alcohol (90 percent) 30 gm.
Distilled water 5 gm.

The results in 50 cases have been most encouraging. The average time a patient was detained in the sick bay was 2½ days. Most of the cases could have been returned to duty within 24 hours; the delay beyond this was to wait return from the laundry of the patients' blankets, mattress covers, and underclothing.

ELECTRIC WELDING

PARTICULARLY EYE HAZARDS AND PROTECTIVE MEASURES[1]

By Lt. T. J. Carter, Medical Corps, United States Navy

As a means of introduction to the subject of electric welding for those who are not familiar with the process, it is believed advisable to give a short definition of the term by Clark. Electric arc welding is a process whereby the parts to be welded are raised to fusion temperature by the passage of an electric current, followed by mechanical pressure to effect the union.[2] Most of this type of work is done by mechanical means, so that the health hazards, ordinarily, are not significant.

Some of the more important hazards are burns, electric shock, injuries to the eyes by foreign bodies, absorption of radiant energy, and inhalation of poisonous gases, dusts, and fumes.

* The Year Book of Dermatology and Syphilology, 1937, p. 418.

[1] From the Division of Preventive Medicine, Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

[2] Clark, J. H.: Nelsons Loose Leaf Medicine. Diseases and Injuries Produced by Radiation.

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Whatever type of welding is being done there is always the possibility of the workers suffering burns by the necessary use of excessively high temperatures, which also present a definite fire hazard. As far as electric shock is concerned, it is needless to say that adequate protective clothing, gloves, etc., must be worn. Many cases of shock occur through carelessness of the workers. It is not only important to guard against electric current which is strong enough to cause injury, but also trivial electric shock which, though harmless in itself, may be sufficient to cause the worker to fall from high places and suffer serious injury.

The inhalation of poisonous gases, dusts, and fumes is a serious health hazard of the welding occupation and it assumes a greater importance because the workers usually are not aware that they are absorbing such poisonous substances until after the effects have been suffered. An illustration of this is seen particularly when there is welding to be done in a confined space. The gases generated by welding are usually due to incomplete combustion. Analyses have been made of the air during electric welding (Galanin) and found to contain 0.018 mg per litre of carbon monoxide, and 4.1 to 112 mg per cubic meter of dust in the form of smoke.[3] The quantity of solids in the atmosphere during welding is determined by filtering a 10-cubic-foot sample of the air through a previously weighed filter (paper, absorbent cotton, and porous sintered filter disk), and the dust weighed on the filter. Methods approved by the American Society for Testing Materials usually are used in analysis, when available and applicable. The dusts formed during welding are in such a finely divided condition that in order to determine the particle size, it is necessary to collect the dust by passing the unfiltered fumes through a gas washing apparatus and examine the insoluble suspended solids in the liquid by microscope, for count and size. It is apparent from filtration tests that considerable quantities of dust are formed in any arc welding operation.

The hazard of gases formed due to incomplete combustion in welding, it might be said in passing, is particularly great in oxyacetylene welding in confined places. Here we have not only the gases due to incomplete combustion but also the acetylene gas which is an asphyxiant. If there is not sufficient oxygen for complete combustion the flame will go out, but before doing so, more than likely the welder is unconscious due to inhaling carbon monoxide. Superimposed upon this deadly gas there is inhaled the pure acetylene gas which tends to make the asphyxiation more profound. The combined result is that the worker will die unless he is soon removed and treated properly.

[3] International Labor Office. Occupation and Health.

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The extreme heat generated in welding causes a volatilization or vaporization of the metal, exposing the worker to metal fumes such as zinc, lead, copper, etc.[4] Experience shows that in enclosed spaces the fumes liberated exercise such a serious effect on the worker that though his work is subject to repeated interruptions, he may at times be exposed to fatal risks.[3] Metal fume fever is not at all uncommon following inhalation of metallic vapors such as copper, silver, iron, cobalt, antimony, and cadmium.

The foregoing emphasizes the fact that when welding in confined spaces, regardless of the type of welding employed, an adequate supply of oxygen, and the use of respirators and power exhaust ventilators for the removal of combustion gases, are necessary.

The most important source of risk in welders is exposure to radiations from the electric arc.[3] The use of electric arc welding, which is used in construction and destructive procedures involving large thicknesses of metal is particularly important in shipyards. The approximate range of rays emitted in this process is from 10 to 10,000 millimicrons, which includes most of the ultraviolet rays, all of the visible light rays, and most of the infrared rays.[5]

Before there can be any effect on any part of the eye, it is necessary that the radiant energy be absorbed by that part of the eye media.[2] At this time it is opportune to mention the range of the absorbing power of the various eye media so as to correlate the absorbing factor with the pathology produced.

The conjunctiva and cornea absorb the ultraviolet rays ranging from 300 millimicrons down. These rays which are very active physiologically will produce a severe conjunctivitis after long exposure, with the possibility of corneal ulcers developing as a complication with subsequent scar formation. After short exposures the conjunctivitis clears up rapidly and no permanent damage is done.

The aqueous humor absorbs ultraviolet radiation no longer than 250 millimicrons, hence it is obvious that no damage can be done to the aqueous by the ultraviolet because the conjunctiva and cornea absorb all the wave lengths up to approximately 300 millimicrons.[2] The vitreous humor absorbs ultraviolet radiation up to 295 millimicrons. Therefore no damage is done to the vitreous by the ultraviolet for the same reason.

Absorption by the lens of ultraviolet varies somewhat with the age of the individual.[6] Wave lengths between 295 and 315 millimicrons are entirely absorbed by the lens, and those between 315 and 400 millimicrons are partially absorbed.[2] Wave lengths of about 300

[2] Clark, J. H.: Nelsons Loose Leaf Medicine. Diseases and Injuries Produced by Radiation.
[3] International Labor Office. Occupation and Health.
[4] Wirtschafter, Z. T., and Schwartz, E. D.: Jour. Indust. Hyg. No. 18.
[5] Metropolitan Life Insurance Company. Health Protection of Welders.
[6] Clark, J. H.: Lighting in Relation to Public Health, ch. 13.

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millimicrons that penetrate the cornea, and also those up to 315 millimicrons may produce changes in the lens protein. The amount of absorption is due to the quality of the lens protein, and the quality is affected by radiation which denatures the protein molecule.

It has been proposed by Berge that denatured lens protein in the presence of an abnormal amount of calcium will be precipitated, thus forming a cataract.[2] He has been able to experimentally produce cataracts by radiating the eyes of fish that had been living in certain amounts of salt solution. Clark has never been able to repeat this experiment with any degree of satisfaction. The denaturation of lens proteins *in vivo* would occur very slowly under ordinary conditions, the effect of which may be accumulative.[2] Longer wave lengths than 760 millimicrons (infrared) when absorbed by the eye media, are transformed into heat energy.

The ability of the eye media to absorb ultraviolet radiation is due to variation in the proteins. The infrared radiation absorbed is due to the presence of water and the eye media have the following absorption equivalents of a centimeter of water: Cornea 0.06; aqueous humor 0.34; lens 0.42; and vitreous humor 1.46, making a total absorption equivalent of 2.28 cc of water for all media.

The heat energy absorbed by the lens varies from 4 to 6 percent, and as the lens cannot lose heat as easily as the cornea, the absorption of heat in the lens may produce serious injury.[2] Cataracts usually are due to a combination of many causes, such as disturbances of nutrition of the body due to disease. Industrial cataracts may be due to the direct action of heat which produces disturbance of the lens nutrition.

Visible light, or wave lengths between 400 and 760 millimicrons, penetrates to the retina producing photo-electric or photo-chemical changes in the retinal cells which produce visual sensations. Long exposure to visible light may produce temporary color changes, and contribute to the production of retinal injuries such as eclipse blindness and snow-blindness.

Adequate eye protection should be given in all occupations which are apt to cause injury to eyesight. In welding metals by means of electric arc, intense radiation shorter than 295 millimicrons is emitted; also intense visible and infrared rays. Therefore, the ideal glass or goggle is that which will filter out all of the ultraviolet and infrared radiation yet giving the greatest visual acuity. Glasses having a gray or neutral tint are the most agreeable to wear as there is no color change.[7] It is important to wear the darkest glass one can use whether black, green, or yellowish-green, in order to obstruct the ultraviolet, visible, and infrared rays.

[2] Clark, J. H.: Nelsons Loose Leaf Medicine. Diseases and Injuries Produced by Radiation.
[7] Coblentz, W. W., and Emerson, W. B.: Bureau of Standards Bulletin No. 93.

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Any ordinary glass protects against ultraviolet light, but for protection against infrared radiation a colored glass, preferably green or black, is desired. There are many types of glasses and goggles of many colors, trade names, and manufacture on the market today. The type of glass for protection must be selected and tested by qualified persons.

The following Navy specifications for welders' goggles are quoted:

Eyecups.—Eyecups shall be adequately ventilated in such manner as to permit circulation of air but not to admit stray light or direct rays from the welding flame.

General.—Goggles shall be fitted with two filter lenses and two cover glasses. Filter lenses and cover glasses shall be made from single solid glass plate, free from striae, waves, flaws, or any defects which will impair their optical quality. The optical surfaces of the filter lenses and cover glasses shall be well polished and free from visible surface defects. The optical surfaces shall not be effectively out of parallel by more than 4 minutes of arc (0.058 prism diopter). Filter lenses shall not be negative in refractive power in any meridian, shall not have a greater positive refractive power in any meridian than 0.13 diopter, and shall not have a greater difference in refractive power between any two meridians than 0.05 diopter. The edges of the filter lenses and cover glasses shall fit the eyecups. If beveled, the edges shall be dull finished.

Filter lenses.—These lenses shall be circular, made from solid plate colored glass, and shall measure 1.968 inch ±0.004 inch (50 mm ±0.1 mm) in diameter and not less than 0.08 inches (2 mm) nor more than 0.12 inch (3 mm) in thickness. Filter lenses shall be in pairs. The lenses of a pair shall have the same total visible transmission, within 20 percent. Visible transmission is based on the percentage of the visible radiation of a gas-filled tungsten lamp operated at normal rating, determined photometrically. The dominant hue shall be yellowish-green unless otherwise specified by the purchaser. If the hue is not evident from inspection, the maximum transparency shall be between 525 and 600 millimicrons, gradually decreasing on either side. Filter lenses shall not be affected by sudden changes of temperature between 40° and 150° F. Each filter lens shall be permanently marked with its shade number.

Cover glasses.—These glasses shall be made from solid plate clear glass, and shall be of the same diameter as the filter lenses. Cover glasses shall be not less than 0.071 inch (1.8 mm) nor more than 0.110 inch (2.8 mm) in thickness and shall have beveled edges when necessary to fit the eyecups specified above. Cover glasses shall transmit not less than 89 percent of the incident visible light. They shall be unaffected by sudden changes of temperature between 40° F. (4.4° C.) and 150° F. (65.6° C.).

A TIME STUDY OF MORBIDITY AND MORTALITY IN THE UNITED STATES NAVY [1]

By Lt. JOHN M. WHEELIS, Jr., Medical Corps, United States Navy

This paper is a preliminary report of research being done with morbidity and mortality records of the United States Navy. It

[1] From the Division of Preventive Medicine, Bureau of Medicine and Surgery, Navy Department, Washington, D. C. This article was presented before the Vital Statistics Section of the American Public Health Association at its annual convention in Kansas City, October 27, 1938, and was submitted concurrently to the American Journal of Public Health and to this bulletin for publication.

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deals principally with technique and basic data. The work is still in progress and only a partial report of results can be given at this time.

Unusual opportunities for research are offered by our data. The procedures for reporting sickness from the field are well defined and long established. The reports cover about 130,000 persons and come from all ships and stations of the Navy. When doing research in Washington, one may rightly consider that he has, as field workers, the 800 medical officers and a portion of the 3,700 hospital corpsmen of the Navy.

Regulations require that anyone not fit for duty at the time of morning sick call be placed on the sick list. Any disability of greater than 24 hours' duration therefore becomes a matter of record and is reported directly to the Section of Vital Statistics in the Bureau of Medicine and Surgery. These reports, though brief, contain all necessary data for complete identification of the individual and of his disability, including the number of sick days. These are known as individual statistical report(s) of patient(s). After having been edited and placed individually on tabulating cards, they become the most important single item in the medical statistics of the Navy. Although they are intended primarily for routine use, they are on file for past years and are available for research. They were used in the present study.

The purpose of this study is to determine what happens to persons as they enter the Navy and grow older in it. This defines LENGTH OF SERVICE as the basic variable. To provide a more homogeneous group and greater statistical continuity, only the enlisted personnel of the Navy were studied. Naval officers, officers and men of the Marine Corps, nurses, midshipmen, and prisoners were excluded. The period of the study is the calendar years 1935 and 1936. About 175,000 person-years are represented.

Description of the population in terms of the basic variable involved considerable detail and some interesting methods.

In the Statistical Section of the Bureau of Navigation there is maintained a living file of naval personnel. It consists of a tabulating card for each man. At the end of each year these cards are checked individually with the annual census from the field. Annually the numbers of personnel, by 4-year length-of-service groups, are reported. For the purposes of this study, the 4-year group was considered satisfactory for those with 4 years' service and over. It was considered necessary, however, to split up the under-4-year group much more finely. This was done by a life table method as will be described.

A man enlisting in January 1931 would just complete 4 years' service in January 1935, the first month of this study. In order to describe the under-4-year group completely for the years 1935 and 1936, it was necessary to follow, during their first 4 years' service, all

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men enlisting from January 1931 to December 1936, inclusive. The number enlisting each month during this period was obtained. Since these were derived from daily reports as received in the mails, they were adjusted for an average, 5-day, postal lag. Each of these groups was then followed separately by identifying, in the dead files, the cards of those who failed to survive their first 4 years' service, that is, the cards of those who left the service within their first 4 years. This produced 72 different survivorship records, beginning with successive months of enlistment, and ending with completion of 4 years' service or with the end of the study. After aligning them in stairstep fashion so that contemporary groups were side by side, it was easy to combine in any monthly grouping desired, during any calendar month of the study. The counts so obtained were adjusted arithmetically to the fifteenth of each month.

Monthly population figures for each of the groups with over 4 years' service were computed arithmetically from the counts as reported annually. Then, for each of the 24 months of the study, figures were recorded for 13 length-of-service groups, as follows: Less than 1 month; 1 month; 2 months; 3–5 months; 6–11 months; 1 year; 2 years; 3 years; 4–7 years; 8–11 years; 12–15 years; 16–19 years; and 20 years and over. Then, by recombining these groups, totals were obtained for comparison with known monthly totals supplied by the Bureau of Navigation. The latter had also to be adjusted for a 5-day postal lag and from the last to the fifteenth day of each month. The range of error in the 24 totals was from 0.03 to 0.67 percent and the average error was 0.20 percent. These errors were adjusted.

A man may be taken up on the sick list in the Navy in any one of five different ways: A—new admission; ACD—a first admission for a condition which complicates, or follows as a sequel of, a contributory disability; EPTE—a first admission for a disability which existed prior to entry into the service; RA—a readmission for a disability previously taken up by any one of the three preceding methods; or, Rem—remaining from the previous year. The sum of the first three A, ACD, and EPTE, represents the total number of first admissions. All five must be considered to determine the number of sick days.

Among other things, length of service and date of admission are shown on each sickness card. Through mechanical sorting and tabulation the data were arranged for recording on basic tables, one for each disability, or group of disabilities, considered. The numbers of first admissions were recorded in each length-of-service group during each of the 24 months.

The numbers of sick days were also distributed along the length-of-service and time variables. The technique for this was rather complicated but the results should be interesting since the numbers of

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sick days represent the actual time lost due to sickness and are, along with mortality rates, the final measure of the effect of sickness in terms of loss of man power.

This work is being done in phases. The first is the communicable diseases, the second the acute respiratory diseases. One would expect close relation of the first to environment. Information is greatly needed about the second.

The present report deals with the communicable diseases. They are loosely defined here as the single attack, droplet-transmitted, acute, specific infections. There were 2,899 such cases distributed as shown in table 1.

TABLE 1.—*Distribution of cases*

German measles	1,132	Septic sore throat	15
Mumps	985	Diphtheria	15
Lobar pneumonia	217	Whooping cough	7
Measles	182	Lethargic encephalitis	3
Scarlet fever	160	Ac. ant. poliomyelitis	3
Chicken pox	103		
Cerebrospinal fever	77	Total	2,899

As men come into the service they arrive from all parts of the country. Some are from cities and have had frequent and diverse contacts with other people. Some are from rural areas where their contact rate was low. During the period of this study about 1,200 new men entered the service each month.

These new men are placed in one of four training stations for their first 3 months' service. They undergo a common experience and are together in groups nearly all of the time. Although their new environment is well controlled and healthful, they are, nevertheless, epidemiologically crowded. Most of them are more crowded than they had been in civilian life. Probably very few are any less crowded. Upon completion of 3 months' training most of them leave for other ships and stations. Some remain for further training. In addition to these new men there are a certain number of older men at the training stations who act as instructors. After leaving the training stations, the new men intermingle with men of all lengths of service and gradually, themselves, grow older in the service.

From the foregoing it can be seen that this study is concerned with more than just the military aspects of changing length of service. We might say that we have a fixed experiment in human epidemiology. Our "herd," so to speak, is the enlisted personnel of the Navy. There is a constant flow of individuals into and out of this herd. The new ones are placed in a "cage," the training stations. A certain number remain for as long as 7 months but most of them leave the cage after 3 months to mingle with the main herd. A smaller number

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of the older members of the main herd return to the cage and are in contact with the new individuals. Having exact data on these movements of individuals and on associated morbidity and mortality, we can study them closely from the experimental epidemiological viewpoint.

We find that, upon combining the 2 years' experience, the person-years were distributed as shown in table 2.

TABLE 2.—*Person-years and numbers of cases by length of service*

Length of service	Number person-years	Number cases	Annual rate per 1,000
Less than 1 month	2,492	129	51.77
1 month	2,427	399	164.40
2 months	2,455	424	172.71
3–5 months	7,209	321	44.53
6–11 months	13,654	255	18.68
1 year	21,707	363	16.72
2 years	14,293	253	17.70
3 years	10,000	167	16.70
4–7 years	36,686	315	8.59
8–11 years	27,871	146	5.24
12–15 years	22,983	80	3.48
16–19 years	13,545	44	3.25
20 years and over	991	3	3.03
Total	176,313	2,899	16.44

The numbers of communicable diseases were as shown in the third column and the annual rates in the last column resulted. When the rates are put in diagrammatic form they produce the picture shown in chart 1. The solid bars represent our rates and the cross-hatched ones show age-specific rates taken from the report by Collins of the

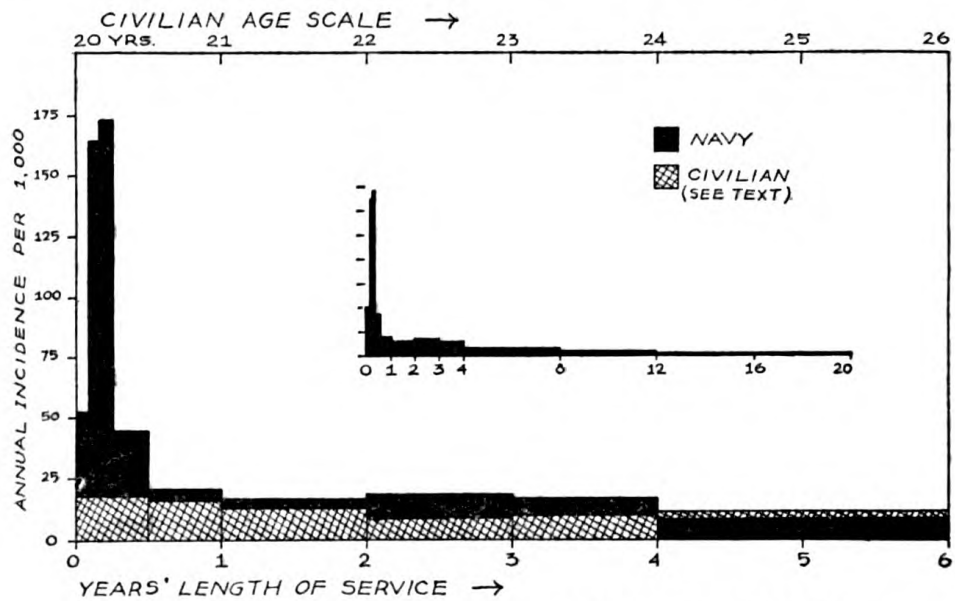


CHART 1.—Communicable diseases, enlisted personnel, U. S. Navy 1935 and 1936.

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incidence among 9,000 white families in 18 States surveyed during 1928–31.[2] Exact comparison of these two sets of rates is not attempted. The civilian rates are included merely as a physical basis for associative comparison. The average age at enlistment was 20.01 years. Age and length of service are necessarily closely correlated. On this basis the civilian rates for the ages 20 to 25 were considered to cover the average ages of men with from 0 to 5 years of service.

During the first month the annual rate of communicable disease incidence is 51.8 per 1,000. During the next 2 months it rises to 172.7. This peak rate, for a group of men slightly over 20 years of age, is the same as that observed by Collins among children 9½ or 10 years of age. The initial rise of incidence is steep and the subsequent drop precipitous. Within 2 months it drops to one-fourth of the peak rate, within 6 months to one-eighth, and within a year to one-tenth. It would be difficult to assume that these rapid changes in incidence are due to changing calendar age. That they are associated with changing environment and adaptation to it seems much more likely.

Seasonal factors are important in the incidence of these diseases. See table 3.

TABLE 3.—*Seasonal incidence of communicable diseases*

	0–2 months' service	3–5 months' service	6–11 months' service	1 year's service and over	Total
January	213.77	48.31	19.86	11.08	22.84
February	498.00	79.73	33.66	18.36	41.98
March	200.33	107.83	37.75	18.57	31.17
April	209.83	85.03	36.77	16.92	27.89
May	156.58	45.87	20.13	14.53	21.04
June	145.90	40.97	17.30	6.81	14.29
July	105.92	25.93	19.41	6.69	12.76
August	43.63	34.91	12.06	3.71	7.23
September	46.55	18.17	8.63	4.22	7.06
October	9.99	10.70	5.31	3.50	4.24
November	17.98	10.29	3.89	3.98	4.88
December	24.82	14.27	10.40	4.65	6.36
Total	129.09	44.49	18.68	9.32	16.44

The seasonal curve for the entire group is as shown in chart 2. This figure presents the vertical column of totals of table 3 in graphic form. The peak is in February and the trough is in October. The peak rate is about 10 times the trough rate.

It becomes of interest to know how the different length-of-service groups responded to seasonal influences during this same period. This response is illustrated in chart 3. For convenience of the diagram and because the groups shown in chart 3 are representative, the 13 length-of-service groups were combined into four as follows: 0–2 months, 3–5 months, 6–11 months, and 1 year and over. Just as was

[2] Collins, S. D.: Pub. Health Rep., 50: 1404 (October 11), 1935.

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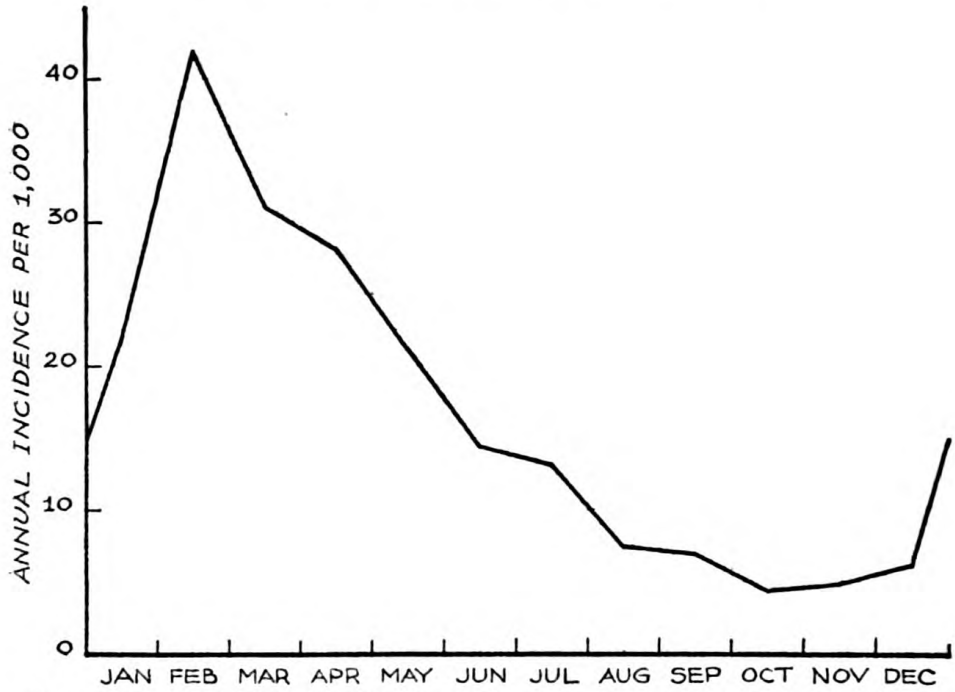


CHART 2.—Communicable diseases, enlisted personnel, U. S. Navy, combined experience 1935 and 1936.

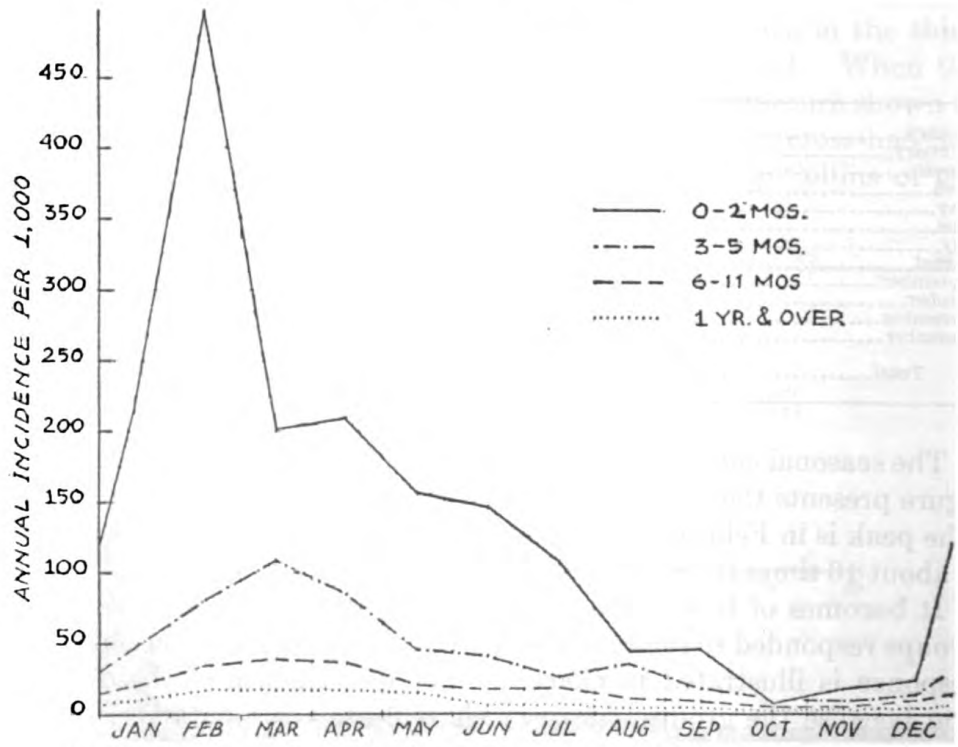


CHART 3.—Communicable diseases, among length-of-service groups, enlisted personnel, U. S. Navy, 1935 and 1936 combined.

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expected from chart 1, the groups with less service have the higher incidence. Only in two instances do any two curves meet, and these are at trough levels. Also, the seasonal peaks flatten out as length of service increases. In order to get away from absolute numbers and to examine more closely the proportional variations of the lower curves, the same seasonal rates were plotted on an arithlog scale in chart 4. Eighteen months are shown in order to avoid breaking the seasonal cycles. Each month represents the combined, corresponding months of the 2 years. For example, the January rate shown here represents both January 1935 and January 1936. The rates are on an annual basis. On the arithlog scale the flattening of seasonal peaks is still apparent. The ratio of peak to trough decreases as length of service increases. In ascending order of the four length-of-service

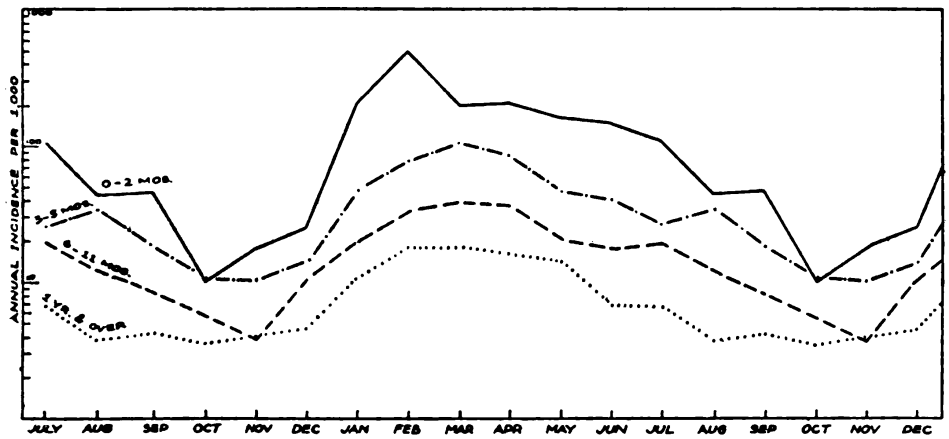


CHART 4.—Communicable diseases by length of service, enlisted personnel, U. S. Navy, 1935 and 1936 combined.

groups, the ratios are 50:1, 10.5:1, 9.9:1, and 5.3:1. As length of service increases the peak tends to come later in the season. In chart 4 the abscissal scale is shown somewhat out of proportion in order to bring out this point.

No attempt is being made at the present time to draw conclusions from the facts which have been presented. Many more approaches are planned. Cook observed that men entering the service during the fall and winter months suffer a much higher incidence of cerebrospinal fever during their first year than those entering during the spring and summer.[3] It will be of interest to know to what extent this holds true for any or all of the other communicable diseases and to split up the phenomenon by single calendar months of enlistment. It will also be of interest from both epidemiological and military points of view to know whether these differences during the first year are equalized during later years.

[3] Cook, S. S.: Am. J. Hyg., 23: 472 (May), 1936.

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Throughout all of this work the training station population and rates can be separated from the others for comparison. It will be of particular interest to know the results of application of these methods to the acute respiratory diseases. Sick days, mortality, and fatality will also be analyzed in the same way.

THE NEW POLICY OF TRAINING NAVAL FLIGHT SURGEONS

By Commander J. C. ADAMS, Medical Corps, United States Navy

Within the past few months the Navy has adopted a new policy concerning the training and qualifications of Navy flight surgeons. The advantages to be derived from this training are numerous and of such a nature as to be of interest to the general service.

Before discussing the broader aspects of this new program of selection and training, and in order that we may have a little better appreciation of just what it means, let us first briefly consider the early history of aviation medicine as concerns the Navy and the early policy of training its flight surgeons. In 1917 instructions dealing with the physical requirements for flying were incorporated in the Manual for the Medical Department. However, the first comprehensive regulations dealing with the physical requirements for aviation training were issued in the form of a circular letter, dated September 15, 1922, and later incorporated in the Manual for the Medical Department. These instructions were in large measure based on the Army requirements as outlined in Army General Order No. 609 and have, with certain modifications, been continued in effect to the present time. It was also in 1922 that the Navy attempted to provide special training for medical officers in the field of aviation medicine. At that time the first naval medical officers were assigned to the course of instruction at the Army School of Aviation Medicine at Mitchel Field, Long Island, N. Y. The subsequent training of naval flight surgeons has been by the periodic assignment of medical officers to the Army School. Insofar as this basic instruction is concerned, I have only the highest praise for the thoroughness and excellence with which the work has been presented. However, as would be expected, in the earlier assignment of Navy flight surgeons to duty with the air forces, many new problems developed. What was to be the relation of the flight surgeon with regards to other medical officers in the service? Was he to be regarded as a specialist? What were to be his relations to the air forces? Was he to receive flight training and compensation for flight hazard, or was he just a medical officer having had special training, but still regarded in the light of a general-duty officer? In our present-day appreciation of what the ideal flight surgeon should

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be, it is hard to realize that many years were required to adjust these matters, and yet such has been the case.

It appears the first obstacle to be overcome was the confusing problem of adjusting the matter of compensation for flight hazard and flight instruction, and the relationship of the flight surgeon to the air forces and the general service. In this regard, it seems that in 1922–23 it was decided to give flight surgeons regular flight training. Three officers actually did complete the basic course of training prescribed for naval aviators. However, they were not given their designation and wings, as they were staff officers, and therefore not entitled to command, as implied by the designation "naval aviator."

This resulted in the complete abandonment of further training along this line. While flying was still encouraged, the policy regarding compensation for flight hazard was almost constantly a matter of controversy and was actually suspended entirely for a period of time. Interest in aviation medicine naturally waned under such a state of confusion, and not until the shortage of flight surgeons finally became acute were measures undertaken in 1935 to restore compensation for flight hazard.

As a further effort to stimulate the interest of flight surgeons, the policy of training a limited number as naval aviators, was again resumed at this time. To date, five such officers have completed this flight instruction and have been designated "naval aviator." Unfortunately, this procedure led to certain administrative complications. The Navy Department limited the total number of flight orders for flight surgeons to such a degree that in order for all serving with the air forces to benefit by these privileges, it became necessary to adopt the policy of rotating the flight orders. It was discovered, however, that rotation could not be applied to flight surgeons designated "naval aviators." It became necessary, therefore, to discontinue such a policy of training, not only because of this fact, but also because such training was largely confined to a few fortunate officers and could not be extended to the group of flight surgeons as a whole. The ultimate effect on morale of the less fortunate ones can readily be seen.

In consideration of all these facts and in the hope of providing a more universal and constructive program of training for future flight surgeons, a new policy regarding their training has been adopted. Briefly, it is based on the following procedure: Medical officers attending the basic course of instruction at the Navy Medical School in Washington, will receive as part of their instruction, a course of lectures by a flight surgeon, dealing with the general and broader aspects of aviation medicine. Upon the completion of these lectures, those who profess an interest and desire to become flight surgeons, will be personally observed by the flight surgeon, with the view of selecting

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those who possess the proper personality and other qualifications necessary for such duty. Those selected for further training are then assigned to the Army School of Aviation Medicine at Randolph Field, Tex., for the basic course in aviation medicine. On completion of this course and in order to receive the designation of "naval flight surgeon," it now becomes necessary to complete the second phase of their training, consisting of 3 months of special flight and ground-school instruction at the naval air station at Pensacola, Fla.

This phase of instruction is entirely new and is regarded as most constructive and important. Briefly, it provides for a total of about 3 months of training, devoted to flight and ground-school instruction, the object of which is to afford the student by actual experience, a practical appreciation of the flying requirements prescribed for the training of a naval aviator.

As stated, this course is divided between actual flight instruction and ground-school studies. The flying includes a total of about 100 hours, roughly divided between instruction in primary seaplanes, primary landplanes, service landplanes and service seaplanes, advanced landplanes, NJ planes, and torpedo and bombing planes.

The flying is naturally dual instruction, except that solo flights are permitted in primary seaplanes. The flight experience provides for the usual aspects of primary training, namely—taxying, take-offs, climbs, straight flying, turns, glides, landings, and emergencies.

In the more advanced flying the student is given primary and advanced acrobatics, formation flying, night flying, blind flying, beam flying, camera gunnery, dog fighting, dive bombing, fixed gunnery runs, torpedo runs, catapult shots, navigational hops, and cross-country flying. Much of this instruction is repeated with the various types of advanced aircraft flown.

The ground-school syllabus provides for 130 hours of classroom and practical work, and 20 hours of collateral reading. Briefly, this part of the syllabus is devoted to such subjects as combustion engines for aircraft, theory of hydrocarbons, aviation fuels, etc., carburation and accessories, operation, upkeep and repair of power plants, principles of ignition, trouble shooting, aerodynamics and theory of design, theory of airfoils, parasite drag, aeroplane overhaul, aircraft gunnery, bombing and smoke screen, radio aids to navigation, aircraft tactics, aerial photography, aerography, including the observation of the preparation of at least five daily weather maps, and advanced studies in special medical problems, dealing with the physical and psychological aspects of the flier. Upon the completion of this training the student will then be given the official designation of "naval flight surgeon," and will at that time be ready for his first duty assignment as a flight surgeon.

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In addition to the foregoing, and in order to provide more advanced training in certain special cases, it is the policy to train an occasional flight surgeon as naval aviator, for use in connection with the problems of physiological research. Others will be given further instruction in psychology and psychiatry, with the objects of using their services in connection with the special personality studies now being conducted on all candidates reporting for flight training.

It is believed this policy of training naval flight surgeons is a step forward. While some of the flight training and ground-school instruction may appear foreign to the needs of the flight surgeon, I believe it will result in the new flight surgeon having a more practical appreciation of the problems confronting him. He will be more capable of intelligent appreciation of aviation problems in general and should therefore be able to serve more efficiently the air forces, of which he becomes a part. While I quite realize that success is dependent to a great degree upon the personality of the individual flight surgeon, I feel this new policy of training will enable him to approach more closely our idea of what a flight surgeon should know and should be.

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NAVAL RESERVE

PROMOTIONS, SECOND QUARTER, 1938

Emil J. Stein, 5300 Warner Avenue, Chicago, Ill., promoted to commander, MC–O, U. S. N. R., July 6, 1938.

Everett H. Dickinson, 250 South Eighteenth Street, Philadelphia, Pa., promoted to lieutenant commander, MC–V (G), U. S. N. R., August 3, 1938.

Silas A. Keim, Wenatchee, Wash., promoted to lieutenant, MC–V (S), U. S. N. R., August 5, 1938.

Merwin L. Hummel, 135 North Center Street, Merchantville, N. J., promoted to lieutenant, MC–O, U. S. N. R., August 5, 1938.

Leonard L. Wilson, Veterans Hospital, Memphis, Tenn., promoted to lieutenant commander, MC–V (G), U. S. N. R., August 5, 1938.

Nathan C. Norcross, University Hospital, Philadelphia, Pa., promoted to lieutenant, MC–V (S), U. S. N. R., September 8, 1938.

Homer A. Beal, 1002–13 Argyle Building, Kansas City, Mo., promoted to lieutenant commander, MC–V (S), U. S. N. R., September 8, 1938.

Ralph E. Duncan, 909 Argyle Building, Kansas City, Mo., promoted to lieutenant commander, MC–V (G), U. S. N. R., September 8, 1938.

RESIGNATIONS, SECOND QUARTER, 1938

Alfey L. Brett, 270 Commonwealth Avenue, Boston, Mass., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted July 14, 1938.

James R. Lisa, 4410 Cayuga Avenue, New York, N. Y., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted July 14, 1938.

Edward L. Saylor, The City Hospital of Akron, Market and Arch Streets, Akron, Ohio, lieutenant, MC–V (S), U. S. N. R., resignation accepted July 14, 1938.

Arthur Bond Cecil, 1016 Pacific Mutual Building, Los Angeles, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted August 6, 1938.

Aura J. Miller, 1021 Cardinal Drive, Louisville, Ky., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted August 6, 1938.

David A. Grendon, 20 West Eighty-sixth Street, New York, N. Y., lieutenant junior grade, MC–V (G), U. S. N. R., resignation accepted August 6, 1938.

Lewis M. Henry, 606 North Twenty-second Street, Fort Smith, Ark., lieutenant, MC–V (S), U. S. N. R., resignation accepted August 20, 1938.

Frederick G. Linde, 490 Post Street, San Francisco, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted August 30, 1938.

Sven Lokrantz, 858 Manning Avenue, Westwood, West Los Angeles, Calif., lieutenant commander, MC–V (S) U. S. N. R., resignation accepted August 30, 1938.

Harold F. Whalman, 1147 Roosevelt Building, 727 West Seventh at Flower, Los Angeles, Calif., lieutenant, MC–V (S), U. S. N. R., resignation accepted August 30, 1938.

Joseph P. Tuttle, 7 United States Nevada Bank, Reno, Nevada, lieutenant, junior grade, MC–V (S), U. S. N. R., resignation accepted August 30, 1938.

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NOTES AND COMMENTS

SULFANILAMIDE

The virtue and danger in the use of sulfanilamide were discussed in a group of articles published in the Bulletin a year ago. The past year has demonstrated the timeliness of these articles. That this new drug possesses therapeutic merit is beyond question. That it still has dangers cannot be denied in the light of extensive and careful observations. That a modified form of the chemical may be found to possess greater therapeutic virtue seems a reasonable possibility that may be anticipated soon.

The issues relating to the use of sulfanilamide, particularly its use in gonorrhea, have seemed sufficiently important to justify publication of another symposium of articles reviewing the literature and recording the results obtained by naval medical officers using this therapeutic agent.

The following brief review of an article by Jones is presented particularly because this author calls our attention to some of the complications arising from the use of sulfanilamide.[1] He concludes that it is neither a magic cure for gonorrhea nor foolproof. After the first 48 hours the body gradually becomes adapted to most of the ill effects of the drug and more tolerant to the organisms. Laboratory findings indicate that the microbe likewise becomes adapted to changed growing conditions and a drug-resistant strain of germs may develop. Many cures are purely symptomatic. More serious yet, contagion has been repeatedly traced to those who could not be proved infectious by ordinary laboratory methods. The carrier harbored an organism not recognizable as a gonococcus by other than cultural methods, but which was capable of reproducing gonorrhea when implanted on a new natural soil.

Self-service, cafeteria-type drug stores run specials on sulfanilamide tablets. Women from brothels take routine self-treatment, particularly before reporting for medical inspection. Many new cases are reporting, apparently as a result of a false sense of security plus the failure of the laboratory to recognize the altered gonococci.

In patients treated with sulfanilamide, slides show that pus cells and epithelial cells are more degenerate; more extraneous organisms are present, and, more confusing still, the gonococcus itself has changed its physical and staining properties. This leads to utter confusion.

Greater care must be exercised in taking, staining, and interpreting slides for gonorrhea than ever before.

[1] Jones, W. R.: Amer. Journ. Syph., Gonor. and Ven. Dis., 22: 349, May 1938.

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FEVER THERAPY IN TREATMENT OF GONORRHEA

While fever therapy is not absolutely free of risk, nevertheless, when the proper technique is employed in the hands of a well-trained team of workers, the dangers are not great. Krusen, Randall, and Stuhler report 1 fatality in the administration of 2,600 treatments to 620 patients.[2]

They found that very few cultures failed to become negative following the administration of a fever of 10 hours. Their conclusion is that fever therapy is of decided value in the treatment of gonorrhea. A single long session of fever therapy, combined in suitable cases with additional local heating, offers the most satisfactory method of treating gonorrheal urethritis, cervicitis, pelvic inflammatory disease, and certain other complications of the infection.

PROSTATITIS

It is the general impression that acute prostatitis is usually a complication of gonorrheal urethritis, whereas Wesson states that the incidence of extension of the gonococcus to the prostate is slight.[3] Chronic prostatitis is as common as tonsillitis. Symptoms of prostatitis and seminal vesiculitis have been aptly described as pus, pain, and rheumatism. A patient with a pain in the lower back or in the groin that extends suprapublically toward the midline below the umbilicus, or down into the scrotum, with a prostate and seminal vesicles that are nodular and indurated on palpation, and whose prostatic secretion contains pus and dead spermatozoa, and who complains of an exacerbation of the pain on massage, has not a beginning hernia or sacro-iliac slip. He has a prostatic backache.

Chronic prostatitis is not infrequently diagnosed as acute appendicitis, and it is not at all unusual for a surgeon to have a patient convalescing from appendicitis and still complaining of the pain for which he was operated. An infected prostate may simulate lesions in distant parts of the body. The millionaire's lumbago or sciatica and the workman's sacro-iliac slip are usually merely prostatic backaches.

ARTICLES OF SPECIAL MERIT, 1938

It has become an established practice for the Surgeon General to present letters of appreciation to authors who have contributed articles of outstanding merit to the NAVAL MEDICAL BULLETIN.

The Surgeon General takes this opportunity to express to all contributors his satisfaction with the excellence of their articles and his appreciation of their support of the Bureau's publication.

For the calendar year 1938 the following authors have received letters of appreciation.

[2] Krusen, F. H., Randall, L. M., and Stuhler, L. G., Am. Journ. of Syph., 22: 185, March 1938.
[3] Wesson, M. B., Journal of Urology, 39: 135, February 1938.

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Rear Admiral H. W. Smith (M. C.), U. S. N. A Formula For Immediate Chemical Prophylaxis. October 1938.

Capt. Lucius W. Johnson (M. C.), U. S. N. Hospital Ships. April 1938.

Capt. Charles J. Holeman (M. C.), U. S. N. Medical Department Function in a Naval Engagement. April 1938.

Commander Frederick L. McDaniel (M. C.), U. S. N. Barbiturate Poisoning. January 1938.

Commander Robert F. Sledge (M. C.), U. S. N. Treatment of Hay Fever With Alum-Precipitated Pollen Extract. January 1938.

Lt. Charles W. Shilling (M. C.), U. S. N. Compressed-Air Illness. January and April 1938.

Lt. Albert R. Behnke (M. C.), U. S. N., and Lt. Oscar D. Yarbrough (M. C.), U. S. N. Physiologic Studies of Helium. October 1938.

FIRST AID

Advance information indicates that the first-aid facilities being provided at the New York World's Fair will include innovations that merit consideration by service personnel. Fair officials estimate that approximately 220 first-aid cases will occur daily. It is even estimated that, during the fair, 18 to 20 calls will be for maternity cases. Eight modern, well-equipped first-aid stations are being provided. This first-aid service will include some distinctly novel features.

The first automobile x-ray unit in existence will proceed to accident cases and photographs will be obtained during the preliminary physical examination and their development completed in the unit's dark room within 5 minutes. Dry ice will be utilized to control the temperature of developing solutions.

Another ambulance will be outfitted with special apparatus to treat cases of asphyxia. The patient will be placed immediately in the ambulance where treatment will be administered while en route to the aid station. Gas anesthesia can be induced, when necessary, to facilitate emergency surgery at the station. This equipment provides modern apparatus manned by trained personnel, prompt evacuation of the patient, and avoids the usual crowd of idle curious incident to accidents.

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BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
United States Naval Medical Bulletin,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

Internships and Residencies in New York City, 1934–37. Their Place in Medical Education. *Report by the New York Committee on the Study of Hospital Internships and Residencies. J. A. Curran, M. D., Executive Secretary.* (461 pp.) The Commonwealth Fund (New York) 1938. Price, $2.50.

Responsibility for a comprehensive study of internships and residencies was assumed by a committee representing the various medical colleges in that city, with the New York Academy of Medicine. The report opens with a historical study showing the gradual growth of the present conceptions of what an internship should mean to the hospital, the intern, and the practitioner. It goes on to consider many factors that contribute to house staff efficiency, hospital libraries and their uses, preparation and training of the intern, organization of the instruction program, capacity of the hospital in relation to quality of the internship, and many other important factors.

The reviewer, seeking profitable application of this report to Navy conditions, found the most interesting parts to be the opinions of interns as to internship, comments of practicing physicians on their internships, descriptions of internships and residencies in selected hospital situations, and descriptions of an intern's day in various types of hospitals. They really take their hair down and talk in one-syllable words, which is most educational.

One conclusion reached is that the progress of the intern throughout his service depends almost equally upon the initiative and vision of the intern himself, and upon the leadership and guidance of the attending staff. Record keeping, hospital libraries, provisions for recreation, and health conservation, were considered important indexes of the quality of instruction offered by the various hospitals.

The concluding paragraph of the summary of findings has a definite bearing on the training afforded to interns in our naval hospitals,

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where those who will run the Medical Corps, decide its standards and policies in the next generation, are now being indoctrinated. "All thoughtful and forward-looking studies of hospital internships and residencies must arrive at the same conclusion—that their primary and essential function is educational. While they serve a useful purpose in the care of the sick in the modern, highly organized hospital, it is only by this practical, supervised experience that the student doctor can be qualified to assume independent responsibility for the care of patients.'

For us, careful selection and painstaking guidance of interns are seen to be the essential features, if we are to see the Medical Department advance during the next generation as much as we like to feel that it has done during the present one.

One wonders how high a mark our naval hospitals which train interns could make on an inquisition which included, among others, such questions as:

Are the completed records carefully inspected by the chief of service before being filed? Are the interns required to complete defective records?

Do the conferences afford the interns an adequate opportunity to assess the quality of their seniors, as well as to be assessed?

Is care taken to include the interns in every phase of hospital activity?

Are they required to take part in conferences, and assisted in their maiden efforts?

Is the system of rotation through the various services adequately arranged?

Does the chief of service give personal attention to the development and instruction of the interns?

TEXTBOOK OF OPHTHALMOLOGY, by *Sanford R. Gifford, M. A., M. D., F. A. C. S., Professor of Ophthalmology, Northwestern University Medical School, Chicago; Attending Ophthalmologist, Passavant Memorial, Cook County, Wesley Memorial, and Evanston Hospitals.* Illustrated. W. B. Saunders Co., Philadelphia and London, 1938. Price $4.

This textbook contains 456 pages of subject matter that is up to date and presented in a clear manner with many excellent illustrations. It is of special value to students and internes in eye clinics.

The chapter on refraction is very good, but we disagree with the author in his treatment of myopia. On page 82 he "considers optical correction only as a means of relieving the symptoms of poor vision and hence prescribes that correction which may be most comfortably worn for use when maximal distant vision is desired." Our procedure is to prescribe the constant use of a full correction.

The author presents all conditions and diseases very clearly and is to be commended for this because size of the book prevents a detailed discussion of anatomy and physiology.

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PRACTICAL OTOLOGY, by *Morris Levine, M. D., F. A. C. S., Clinical Professor of Otolaryngology, New York Post Graduate Medical School, Columbia University; Attending Otolaryngologist, New York Post Graduate Hospital.* Second edition, thoroughly revised. Lea and Febiger, Philadelphia, 1938. Price $5.50.

Practical otology, by Dr. Levine lives up to its name, and is recommended by the reviewer for use by both students and specialists. Although small, when compared with other medical text books, the author has covered extensively diseases and conditions of the ear and their inter-relation with the rest of the body.

The material presented is clear and concise, and the moderate number of illustrations is quite adequate. New subject matter discussed quite thoroughly is petrositis.

The author in his discussion of treatment of the various infectious conditions recommends roentgen-ray therapy and sulfanilamide, each in its own place. The reviewer agrees with Dr. Levine that although these two therapeutic agents have been hailed as panaceas by some, their real value is quite limited.

PHYSIOLOGY IN HEALTH AND DISEASE, by *Carl J. Wiggers, M. D., Professor of Physiology in the School of Medicine of Western Reserve University, Cleveland, Ohio.* Second edition, thoroughly revised. Illustrated with 191 engravings. Philadelphia, Lea & Febiger, 1937. Price, $9.

This work contains a wealth of information, well organized, well written, and of the greatest importance to the study and understanding of physiology in its relation to modern clinical medicine. It is a storehouse of critically selected information, of equal value to those who are essentially interested in pure physiology and to clinicians and pathologists. The material is so organized as to make essential facts readily accessible. The index and bibliographies are ample.

In this (second) edition, the discussions of many topics which were treated but briefly in the first edition have been expanded, including the biophysical principles, special senses, neurohumoral agents, pain, and pulmonary affections. The language has been clarified and the presentation simplified throughout. Clinical material has been used in the discussion of physiologic principles, and the facts and conceptions established by experiment are applied to the analyses of clinical conditions.

Here is a happy combination of basic principles and practical applications, of value alike to the student, the physiologist, and the practicing physician in any line of work.

MACLEOD'S PHYSIOLOGY IN MODERN MEDICINE, edited by *Philip Bard, Professor of Physiology, Johns Hopkins University School of Medicine,* with eight collaborators. Eighth edition. 1,051 pages. C. V. Mosby Co., St. Louis, 1938. Price $8.50.

The present volume is the first edition of this work since Professor MacLeod's death. Professor Bard has extended the practice, adopted

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by Professor MacLeod, of inviting collaboration by outstanding investigators.

Accordingly each major section is the work of a physiologist active in that field. The sections contain a greater wealth of detail than is generally found in such a text and are thus designed to stimulate the student to weigh the evidence and achieve an understanding by selection and coordination of facts. The book makes no pretense of being a text of applied physiology. The writers have brought in clinical data only when it illustrated fundamental physiological principles. Thus the reader who expects to find predigested knowledge, suitable for immediate bedside application, will be disappointed.

The aim of the authors has been to acquaint the student in his undergraduate days with the solution of fundamental physiological problems and to give him an appreciation of the nature of valid experimental evidence.

As each subject has been treated by a writer who is engaged in original work in that sector of physiology, recent advances are fully treated.

References listing original sources of information with complete titles are remarkably complete and will serve as aids in further investigation of each phase of the subject.

PHYSIOLOGICAL AND CLINICAL CHEMISTRY, by *William A. Pearson, Ph. C., M. D., Ph. D., Phar. D., Sc. D., LL. D., Professor and Head of the Department of Chemistry and Physiological Chemistry in the Hahnemann Medical College and Hospital of Philadelphia* and by *Joseph S. Hepburn, A. M., B. S. in Chem., M. S., M. D., Ph. D., Associate Professor of Chemistry and Research Associate in Gastroenterology in the Hahnemann Medical College and Hospital of Philadelphia; Assistant Director of the Constantine Hering Research Laboratory.* Second edition. 467 pages. Lea & Febiger, Philadelphia, 1938. Price $5.50.

The aim of the book is to present the essential facts of the subject for the physician and medical student. This it does in an excellently readable and understandable fashion and without unnecessary verbosity. It is not a complete and exhaustive text or a bench manual for the clinical pathological laboratory. It presents essential facts with the background discussion considered necessary for understanding and application.

It is divided into three sections. The first part covers a review of essential points in the physiological chemistry of the lipins, carbohydrates, proteins, enzymes, and composition of tissues. The second section treats of foods and metabolism. Section three includes chapters on the clinical chemistry of salivary and gastric digestion, intestinal digestion, including bile and pancreatic juice, feces, blood and cerebrospinal fluid, urine, milk, and water from the sanitary aspect.

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TEXTBOOK OF BACTERIOLOGY, by *Thurman B. Rice, A. M., M. D., Professor of Bacteriology and Public Health at the Indiana University School of Medicine.* Second edition. 563 pages. Illustrated. W. B. Saunders Co., Philadelphia. 1938. Price $5.

This is a good book. It should serve well as a textbook for medical students, general students of medical bacteriology, or those studying it from the standpoint of dentistry, pharmacy, or nursing. Practicing physicians too busy to tackle a thicker and more detailed book will find through this easy reading volume a painless way to remind themselves of the things about bacteriology they may have long forgotten, and at the same time review the latest knowledge and methods in this important basic medical science.

Dr. Rice evidences a good understanding of the needs of the student and general practitioner through his predominantly clear style. He includes much forceful common sense and many practical instructions in technical procedure.

LABORATORY MANUAL OF HEMATOLOGIC TECHNIC, by *Regena Cook Beck, M. A., M. D., Formerly Instructor in Pathology and Bacteriology at George Washington University Medical School; Head of the Department of Bacteriology, William and Mary College Extension; Pathologist to Stuart Circle Hospital and Director of the Stuart Circle Hospital School of Medical Technology, Richmond, Va.* First edition. 389 pages. Illustrated. W. B. Saunders, Philadelphia. 1938. Price $4.

This book is a handy guide for the technician and for students of medical technology. A standard method for practically all the clinical tests used in haematology is given, but a number of methods described are evidently those using the author's choice of apparatus, thereby, for many, necessitating reference to other manuals. The parts devoted to special studies and special blood pathology are of particular value. The terms to learn and questions to answer, which are given at the end of each chapter, are valuable both to the student and teacher. The brief interpretations of the various tests are of value to the clinician. The blank charts scattered throughout for the use of the student in recording results of various tests might well have been omitted as they only serve to pad the book. The printing and binding are of excellent quality.

PATHOLOGICAL TECHNIQUE, by *Frank Burr Mallory, A. M., M. D., S. D., Consulting Pathologist to the Boston City Hospital, Boston, Mass.* First edition. 434 pages. Illustrated. W. B. Saunders Co., Philadelphia and London, 1938. Price $4.50.

For a number of years every one interested in pathological technique has wished for a revision of the classic on pathological technique, by Mallory and Wright. This book is not a revision but is an entirely new book written by one of the co-authors of the old, and is its worthy successor.

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As the author states in his preface he has retained the best methods of the past and has added only the most promising ones of the present. It contains most of the practical methods for the fixing, embedding, cutting, and staining of pathological material, and, in addition, has a most valuable section on postmortem technique.

The illustrations are few in number. It is well printed and bound and is recommended for the workbench of every pathological laboratory.

PARASITOLOGY, by *Robert Hegner, Ph. D., Professor of Protozoology, The Johns Hopkins University; Francis M. Root, Ph. D., late Associate Professor of Medical Entomology, The Johns Hopkins University; Donald L. Augustine, Sc. D., Assistant Professor of Helminthology, Harvard University;* and *Clay G. Huff, Sc. D., Associate Professor of Parasitology, University of Chicago.* 812 pages. Illustrated. D. Appleton-Century Co., Inc., New York, 1938. Price $6.

This is a revision of the 1929 edition. The authors seem to have accomplished the object of the revision, "to include the results of additions to our knowledge that have been made during the past 9 years." On the whole, recent findings and opinions of research workers and other observers have been carefully evaluated and received due consideration and space. The book can be relied upon to give the reader the important down-to-date facts on the many parasites of importance to physicians and veterinarians. The various subjects are clearly presented under well chosen headings. An occasional repetition of facts under the two headings, Life-Cycle and Morphology, is probably made intentionally for the benefit of the student reader.

The book is printed on paper with a yellowish tint instead of the white paper used in the first edition. This change does not appear to be an improvement. On the contrary, the text is less pleasant to read and the illustrations less impressive. This edition does not appear to have been edited as carefully as the first, being marred by not a few typographical errors.

HUMAN PATHOLOGY, by *Howard T. Karsner, M. D., Professor of Pathology, Western Reserve University, Cleveland, Ohio.* Fifth edition. 1,013 pages. Illustrated. J. B. Lippincott Co., Philadelphia and London, 1938. Price $10.

The great multitude of subjects that must necessarily be included in a text of pathology has been well covered in this book.

It has been thoroughly revised and most of the new knowledge which has been developed during the 3 years since the appearance of the fourth edition, has been added.

The material is logically arranged for the progressive study of the student. The various subjects have been discussed from the etiological and disturbed physiological viewpoints as well as from the standpoint of pathological anatomy.

The book contains 461 excellent illustrations of which 18 are in color, and a comprehensive list of references is given. It is convenient

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in size and is recommended both as a text for students and as a reference for physicians.

MATERIA MEDICA, PHARMACOLOGY, THERAPEUTICS, AND PRESCRIPTION WRITING, by *Walter Arthur Bastedo, Ph. M., M. D., Sc. D., F. A. C. P. President United States Pharmacopoeial Convention 1930–1940; Member of the Revision Committee of the United States Pharmacopoeia; Instructor in Pharmacology, Cornell University; Attending Physician, City Hospital, New York.* Fourth Edition. 778 pages. Many illustrations. W. B. Saunders Co., Philadelphia and London. 1937. Price $6.50.

This is a good book for the practicing physician. In brief it tells how drugs act, conditions under which they may be beneficially used, and how to use them.

The style and arrangement of previous editions has been followed. This edition has been brought into conformity with the eleventh edition of the United States Pharmacopoeia and the sixth edition of the National Formulary. The first 39 pages contain the usual introductory matter found in a book on materia medica. The next 650 pages contain detailed discussions of the individual remedies classified therapeutically. The last 18 pages tell the physician how to solve the problem of prescription writing.

The author emphasizes established facts, both laboratory and clinical, considered to be of practical importance to the practicing physician. On controversial or unsettled matter the obtainable data has been well presented. There is presented under each remedy an interesting and condensed review of the recently published researches in chemistry, bacteriology, physiology, pharmacology, and clinical medicine. There is much physiology interwoven through the pharmacological and therapeutic discussions.

Much space has been given to the important remedies, while remedies of questionable value are only briefly discussed or not mentioned. It contains an excellent discourse on digitalis.

THE PNEUMONIAS, by *Hobart Reimann, M. D., Professor of Medicine, Jefferson Medical College, Philadelphia; formerly Professor of Medicine, University of Minnesota; formerly Associate Professor of Medicine, Peking Union Medical College, Peking, China.* First edition. 381 pages. Illustrated. W. B. Saunders Co., Philadelphia. 1938. Price $5.50.

The subject of pneumonias is one of the most important in medicine to which every textbook devotes considerable space. This monograph is a most valuable adjunct to any text as it gives more emphasis to the etiological, pathogenic, and roentgenographic standpoint rather than to the time-honored physical signs and gross pathology; which, however, are not wholly neglected.

Pneumococcus pneumonias are classified according to type of the organism, and the treatment by specific immune serum and chemotherapy fully discussed. Atypical pneumonias, coccal, bacillary,

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virus, and fungi are discussed, as are the ones occurring as part of a systemic disease and those secondary to acute and chronic diseases, including postoperative pneumonia.

A section is devoted to the specific forms of pneumonia not caused by infection, such as those caused by oil aspiration, radiation, chemicals, and allergy.

A summary of most of the newer knowledge on the subject is included, and any person having to do with the treatment of pneumonia will find in it a valuable fund of information.

THE PATHOLOGY OF DIABETES MELLITUS, by *Shields Warren, M. D., Pathologist to the New England Deaconess Hospital, The New England Baptist Hospital, The Huntington Memorial Hospital, and the Pondville State Hospital; Director of Massachusetts State Tumor Diagnosis Service; Assistant Professor of Pathology in the Harvard Medical School, Boston, Mass.* Second edition. 246 pages. Illustrated. Lea & Febiger, Philadelphia. 1938. Price $4.75.

This book is a well-written monograph covering almost every phase of the pathology of diabetes mellitus and its complications. It is probably more important that the clinician treating this disease should have a thorough understanding of its pathology than it is for the pathologist.

To quote from Joslin's foreword to the first edition of this book, "this is a pathology of and for the living almost as much as of the dead."

It is recommended to anyone interested in the subject of diabetes mellitus.

APPLIED ANATOMY. Functional and Topographical, by *Robert H. Miller, M. D., Associate Professor of Anatomy in the University of Tennessee, College of Medicine, Memphis, Tenn., formerly Associate Professor of Surgery in Charge of Operative Surgery; formerly Attending Surgeon to the Memphis General Hospital, Memphis, Tenn.* 469 pages, 71 illustrations. Lea & Febiger, Philadelphia. 1938. $6.50.

At the very outset the author has set up an almost insurmountable obstacle in his preface, wherein he states that: "This volume attempts to correlate the facts gained by observation in the laboratory and apply them to the dynamics and function of the living body . . . Comparative anatomy, phylogeny, and morphology have been enlisted wherever they could aid the comprehension of coordinated function and activity of the structures."

Let not the student be daunted by this verbal barrier, however. If he will persist, and be of strong heart, he will be rewarded by finding a rich repast of anatomical facts, agreeably presented, attractively served, and easily assimilable. The anatomical observations are tied in with their clinical applications in such a pleasant manner that the student will find enjoyment as well as profit in his reading.

This book should prove a valuable guide along the difficult and unaccustomed path of anatomy for the beginner.

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SURGICAL PATHOLOGY, by *William Boyd, M. D., LL. D., M. R. C. P. Ed., F. R. C. P. Lond., Dipl. Psych., F. R. S. C., Professor of Pathology, University of Toronto.* Fourth edition. 886 pages with 47 illustrations. W. B. Saunders, Philadelphia. 1938. Price $10.

The first edition of this book appeared 13 years ago and, needless to say, it needs no introduction to the surgeon or to the pathologist. The material is omitted in which the surgeon is not particularly interested, and more detailed information given on those subjects which he must know. For the pathologist examing surgical specimens it is an excellent book of reference.

A number of entirely new subjects have been added to this edition, among which are the following: Hashimoto's Disease, regional ileitis, lymphogranuloma inguinale, pilonidal cyst, Brenner's tumor, granulosa cell tumor, and arrhenoblastoma of the ovary, glomangioma and tumors of the islets of Langerhans.

In the revision much new material has been included in many other subjects. Of particular interest are the following: Etiology of tumors, liposarcoma, endometrial hyperplasia, the relation of chronic mastitis to carcinoma of the breast, etiology of appendicitis and anaerobic streptococci in puerperal sepsis.

It is profusely illustrated with excellent photographs, drawings, and color plates. As is usual with all of Boyd's books it is written in an easily readable style. The volume is well printed, excellently bound, and is recommended to all interested in pathology.

A MANUAL OF REPARATIVE PLASTIC SURGERY, by *J. Eastman Sheehan, M. D., F. A. C. S., Professor of Reparative Plastic Surgery, New York Polyclinic Medical School and Hospital; Surgeon, St. Clare's Hospital; Consulting Surgeon, Morrisania City Hospital, New York; Honorary Professor de la Academia de Sanidad Militar, Spain.* 304 pages, 314 illustrations. Paul B. Hoeber, New York. 1938. $5.50.

This book represents the most successful effort yet made to cover the field of plastic reparative surgery in a single volume. For the specialist, it provides a ready reference with the details of that seldom-used operation. For the general surgeon, it gives advice on the best plastic methods to be used, and the myriad details of technique which make the difference between success and failure. For the student, it is a useful guide, showing what is tried and true, practical, and worth while in the field of plastic surgery.

Not the least of its virtues lies in the things that have been deleted. It does not pretend to teach bacteriology to the surgeon, or tooth extraction to the dentist, as other recent textbooks on plastic surgery have done. Best of all, one finds no trace of those pages of diagrams of alleged plastic operations, bearing the names of pioneers from Tagliacozzi to Szymanowski, that have persisted through generations of surgical textbooks. Many of them obviously impractical, and doomed

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to failure if they ever were employed, those apocryphal diagrams continue to recur, even in recent publications.

The author of this volume is known for his artistic ability as well as for his surgery. He writes clearly and with authority. One can follow his advice and directions with complete confidence.

EXPERIENCE IN THE MANAGEMENT OF FRACTURES AND DISLOCATIONS (based on an analysis of 4,390 cases), by *the Staff of the Fracture Service, Massachusetts General Hospital, Boston.* Under the general editorship of *Philip D. Wilson, M. D.* 1,022 pages, 1,419 illustrations. J. B. Lippincott Co., Philadelphia. 1938. Price $15.

Most of the criticisms that one might bring against this book are admitted, in advance, in the preface. Thus there is little left for the reviewer except to parade its virtues, which are many.

It is, in reality, a collection of 34 monographs, each prepared by one who is thoroughly conversant with his subject. The first 30 chapters relate to fractures and dislocations in the various regions of the body, while the last four cover general topics. The treatment of the subject matter is unusual. For instance, the chapter on lesions at the elbow has 33 pages devoted to general considerations, a summary of 280 cases, and 41 pages of abstracted case reports. Many of these are so thoroughly condensed that all the valuable matter seems squeezed out, and one wonders why they were included.

Such a monumental volume represents an enormous amount of work, both clinical and clerical, and it is the epitome of a great number of cases. One cannot avoid the wish that he might fall into the hands of such a group, should he suffer a fracture. Yet the conclusion is justified that the statistician has many times overswayed the clinician in the choice of material for inclusion. The physician who writes a paper on fractures must not fail to consult this book, but one who has a fracture patient in the waiting room might do better to seek another volume.

CLINICAL ROENTGEN THERAPY, by *Ernst A. Pohle, M. D., Ph. D., F. A. C. R., Professor of Radiology, Chairman, Department of Radiology and Physical Therapy, in the University of Wisconsin.* Foreword by *George W. Holmes, M. D., Roentgenologist to the Massachusetts General Hospital and Clinical Professor of Roentgenology in Harvard Medical School.* 819 pages illustrated with 199 engravings. Lea & Febiger, Philadelphia, 1938. Price $10.

The joint endeavor of Dr. Pohle and the 16 nationally and internationally known contributors has resulted in the publication of a comprehensive textbook on roentgen therapy. The rapid advances made in roentgen therapy in recent years has made it imperative for roentgenologists to have a reliable and conservative textbook on roentgen therapy by a recognized authority. It is now available in this excellent edition.

This book will be particularly valuable to roentgenologists of less experience than the author and to those who need the advice of these

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more experienced contributors. Twelve chapters cover the field of roentgen therapy in an interesting and entertaining style. When the second edition of this book is published, it will certainly, we hope, have one chapter devoted to the treatment of infections.

ANUS, RECTUM, AND SIGMOID COLON. Diagnosis and Treatment, by *Harry E. Bacon, M. D., F. A. C. S., F. A. P. S., Assistant Professor of Proctology, Temple University School of Medicine; Associate in Proctology, Graduate School of Medicine, University of Pennsylvania.* Foreword by *J. P. Lockhart-Mummery, M. A., M. B., B. Ch. (Contab.), F. R. C. S. (Eng.), Emeritus Surgeon, St. Mark's Hospital, London, England.* Introduction by *W. Wayne Babcock, M. D., LL. D., F. A. C. S., Professor of Surgery, Temple University School of Medicine.* 804 pages, 487 illustrations in the text, mostly original by William Brown McNett. J. B. Lippincott Co., Philadelphia, 1938. Price $8.50.

This is a truly encyclopedic work. One wonders how such a busy specialist could have found time to digest such a huge mass of material. It is easy to believe that, as the author states, it has consumed over 7 years of concentrated study and practice. The result is a valuable book. Young practitioners will find diagnosis, pathology, and treatment expressed clearly; while the specialist will appreciate its complete description of the rarer conditions and less common operations. The opinions expressed, and the advice given, are intensely practical.

Sinuses and cysts of the sacrococcygeal region, a matter of great interest to doctors in the Navy, occupy 35 pages. There is an excellent account of the embryology and the developmental causes for their occurrence, also a full discussion of the various types and their treatment, well illustrated. It is interesting to note that he prefers excision en bloc for the pilonidal cyst, with the wound left open to granulate. There is a study of the percentage of recurrences after the various modes of treatment, but no consideration of the number of convalescent sick days, an important matter to us.

Chordoma, unfortunately omitted from the index, is a first-class example of the concise, yet thorough manner in which the rarer conditions are described.

THE PRACTICE OF UROLOGY, by *Leon Herman, B. S., M. D., Professor of Urology, University of Pennsylvania, Graduate School of Medicine, Urologist to the Pennsylvania Hospital and to the Bryn Mawr Hospital, Consulting Urologist to the Methodist Episcopal and Burlington County (N. J.) Hospitals.* W. B. Saunders Co., Philadelphia and London, 1938. $10.

No better words can be found to describe this book than those of the author, taken from the first portion of the preface: "This volume fulfills my ambition to prepare a practical treatise on diseases of the urogenital system. It is intended particularly for the use of the general practitioner and surgeon. With the needs of these ever in mind I have dealt largely with methods and procedures employed daily in

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diagnosis and treatment. Special care has been taken to arrange the subject matter in a readily available form. The principles of urology are discussed at a length sufficiently to make the book valuable also for students of the subject. Controversial problems are presented adequately when such discussion seems necessary to clarify the subjects from the practical standpoint. Considerable space is devoted to diagnosis, and especially to the proper order of application of available methods. The sections on gonococcal infections and their sequelae, and venereal ulcerations are extensive, but this is justified by their great importance." This book contains 923 pages divided into 11 parts as follows: 1. Diagnosis; 2. Instrumental Therapeutics in Urology; 3. The Kidney; 4. The Ureter; 5. The Urinary Bladder; 6. The Urethra; 7. The Penis and Scrotum; 8. The Testicle, Spermatic Cord, and Seminal Vesical; 9. The Prostate Gland; 10. Urolithiasis; 11. Urogenital Tuberculosis and Actinomycosis, and Urinary Syphilis. Each part is subdivided into chapters, 57 in all, with each chapter the title of the phase of the subject under discussion. 504 illustrations add considerably to its value. The author is to be congratulated for producing a text that attains his objective so well.

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THE DIVISION OF PREVENTIVE MEDICINE

Commander C. S. STEPHENSON, Medical Corps, United States Navy, in charge

TOXIC EFFECTS OF ARSENICAL COMPOUNDS

AS EMPLOYED IN THE TREATMENT OF DISEASES IN THE UNITED STATES NAVY, 1937

By Commander C. S. STEPHENSON, Medical Corps, United States Navy, and E. H. WINGO, Chief Pharmacist's Mate, United States Navy

Since November 1924 medical officers of the Navy have been required to make monthly reports of the number of doses of arsenicals administered and a separate account of each case in which ill effects are noted. During the 13 years, 1925–37, in which this information has been compiled 1,309,794 doses of arsenicals have been administered and 973 reactions have been reported.

Previous articles dealing with the information obtained from these reports have been published in the following issues of this bulletin.

September 1925.	October 1933.	October 1936.
January 1927.	October 1934.	January 1937.
January 1929.	January 1935.	October 1937.
July 1930.	October 1935.	January 1938.
October 1931.	January 1936.	October 1938.
October 1932.		

Cases of arsenical dermatitis occurring during the year 1937 were published in the October 1938 issue.

The present article includes all cases, except arsenical dermatitis, which were reported during the year 1937. Comparative figures from the experience of previous years are also presented.

TABLE 1.—*Arsenical reactions, 1937*

Classification	Neoarsphenamine, sulpharsphenamine, mapharsen, and tryparsamide reactions [1]			
	Mild	Severe	Fatal	Total
Arsenical dermatitis	17	9	0	26
Vasomotor phenomena	13	0	0	13
Blood dyscrasias	3	0	0	3
Gastro-intestinal	2	0	0	2
Hemorrhagic encephalitis	1	0	1	2
Liver damage	0	1	0	1
Jarisch-Herxheimer	1	0	0	1
Optic neuritis	1	0	0	1
Total	38	10	1	49

[1] Case histories were published in the October 1938 number of the bulletin. Included in the above table is one severe reaction caused by mapharsen, 1 mild reaction caused by sulpharsphenamine, and 1 mild reaction caused by tryparsamide.

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TABLE 2.—*Arsenicals administered during the year 1937 for all diseases*

Drug	Dose (grams)				
	0.9 to 3	0.9	0.6 to 0.9	Less than 0.6	Total
Arsphenamine:					
Navy	0	0	68	1,176	1,244
All others	0	0	7	595	602
Bismarsen:					
Navy	0	0	0	424	424
All others	0	0	0	107	107
Mapharsen:					
Navy	0	0	0	9,101	9,101
All others	0	0	0	1,559	1,559
Neoarsphenamine:					
Navy	0	170	30,884	40,438	71,492
All others	0	15	3,615	10,742	14,372
Silver arsphenamine:					
Navy	0	0	0	10	10
All others	0	0	0	0	0
Sulpharsphenamine:					
Navy	0	0	40	494	534
All others	0	4	166	803	973
Tryparsamide:					
Navy	5,727	0	0	0	5,727
All others	1,492	0	0	0	1,492
Total	7,219	189	34,780	65,449	107,637

TABLE 3.—*Arsenicals administered during the 6-year period, 1932-37, for all causes*

Drug	Dose (grams)				
	0.9 to 3	0.9	0.6 to 0.9	Less than 0.6	Total
Acetarsone:					
Navy	0	0	0	140	140
All others	0	0	76	729	805
Arsphenamine:					
Navy	0	0	149	10,297	10,446
All others	0	0	7	706	713
Bismarsen:					
Navy	0	0	0	1,176	1,176
All others	0	0	1	655	656
Mapharsen:					
Navy	0	0	0	11,094	11,094
All others	0	0	0	2,441	2,441
Neoarsphenamine:					
Navy	0	4,928	229,319	324,734	558,981
All others	0	395	28,199	89,711	118,305
Silver arsphenamine:					
Navy	0	0	0	350	350
All others	0	0	0	204	204
Sulpharsphenamine:					
Navy	0	18	281	7,295	7,594
All others	0	7	209	9,613	9,829
Tryparsamide:					
Navy	21,658	0	0	10	21,668
All others	10,457	0	0	5	10,462
Total	32,115	5,348	258,241	459,160	754,864

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TABLE 4.—*Deaths and severe reactions following administration of 1,172,843 doses of neoarsphenamine, 1925–37; ratio of deaths and severe reactions to doses*

Classification	Deaths		Severe reactions		Deaths and severe reactions	
	Number	Ratio to doses 1 to—	Number	Ratio to doses 1 to—	Number	Ratio to doses 1 to—
Hemorrhagic encephalitis	16	73,303	1	1,172,843	17	68,991
Arsenical dermatitis	10	117,184	179	6,552	189	6,206
Vasomotor phenomena	6	195,474	56	20,944	62	18,917
Blood dyscrasias	5	235,569	18	65,158	23	50,993
Acute renal damage	2	586,422	5	235,569	7	167,549
Acute yellow atrophy of the liver	2	586,422	0		2	586,422
Vascular damage (probable renal hemorrhage)	1	1,172,843	0		1	1,172,843
Liver damage	0		15	78,190	15	78,190
Jarisch-Herxheimer	0		2	586,422	2	586,422
Gastro-intestinal	0		2	586,422	2	586,422
Polyneuritis	0		1	1,172,843	1	1,172,843
Border-line hemorrhagic encephalitis	0		1	1,172,843	1	1,172,843
Arsenical neuritis	0		1	1,172,843	1	1,172,843
Optic neuritis	0		1	1,172,843	1	1,172,843
Total	42	27,925	282	4,159	324	3,620

TABLE 5.—*Deaths following administration of arsenical compounds, 1919–37*

Year	Arsphenamine	Neoarsphenamine	Total	Year	Arsphenamine	Neoarsphenamine	Total
1919	3	0	3	1930	0	3	3
1920	1	1	2	1931	0	0	0
1921	3	1	4	1932	0	4	4
1922	0	4	4	1933	0	7	7
1923	0	1	1	1934	0	3	3
1924	1	2	3	1935	0	2	2
1925	0	2	2	1936	0	3	3
1926	0	4	4	1937	0	1	1
1927	1	4	5				
1928	0	6	6	Total	9	51	60
1929	0	3	3				

NUMBER OF PERSONS TREATED FOR SYPHILIS AND OTHER DISEASES

Annually on December 31 each activity records and reports to the Bureau of Medicine and Surgery, on N. M. S. form A, the number of persons in that command who have a history of syphilis, and the number of those in the command who were treated during the year with an arsenical compound, heavy metal, or other antiluetic treatment. The census also requires the recording and reporting of the number of persons who were treated during the year with an arsenical compound for a disease other than syphilis. This census does not take into account those individuals who left the service during the year.

In the table which follows, treatment data have been separated into that given to active service personnel and that given to all others. The term ALL OTHERS includes Veterans' Administration patients, dependents of naval personnel, retired naval personnel, and native populations of insular possessions.

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TABLE 6.—*Syphilis and arsenicals, U. S. Navy, 1937*

	Persons		
	U. S. Navy and Marine Corps	All others	Total
Strength, Dec. 31, 1937	133,501	----------	133,501
Syphilis census, Dec. 31, 1937	13,887	----------	13,887
Number of persons treated for syphilis with:			
Arsenicals:			
Arsphenamine	66	11	77
Bismarsen	28	21	49
Mapharsen	831	160	991
Neoarsphenamine	4,734	945	5,679
Silver arsphenamine	1	0	1
Sulpharsphenamine	59	83	142
Tryparsamide	270	89	359
Total persons treated with arsenicals	5,989	1,309	7,298
Heavy metal compounds:			
Bismuth compounds	4,573	776	5,349
Mercury compounds	303	28	331
Mixed treatment (specific mixture, etc.)	41	4	45
Potassium iodid	130	17	147
Total persons treated with heavy metal compounds	5,047	825	5,872
Number of persons treated for disease other than syphilis with:			
Arsenicals:			
Arsphenamine	9	0	9
Mapharsen	1	0	1
Neoarsphenamine	333	2,455	2,788
Sulpharasphenamine	1	74	75
Fowler's solution	30	0	30
Total persons treated with arsenicals	374	2,529	2,903
Heavy metal compounds: Bismuth compounds	1	64	65

In table 6 it will be noted that 374 service personnel and 2,529 non-service personnel were treated for diseases other than syphilis with arsenical compounds during the year 1937.

Of the 374 naval personnel, 321 were treated for Vincent's infection, 12 were treated for acne, 15 treated for gingivitis, 2 treated for yaws, and 24 treated for other diseases and conditions.

Of the 2,529 persons in the group ALL OTHERS, 2,499 were treated for yaws, 28 treated for Vincent's infection, and 2 treated for other diseases and conditions.

VASOMOTOR PHENOMENA

Neoarsphenamine.—(27—1937.) On October 28, 1935, 2 months after repeated exposures to infection, this patient developed multiple penile lesions. A Kahn blood test was 4-plus on November 4, 1935, and darkfield examinations were repeatedly negative. From November 4, 1935, to Febriary 6, 1936, he received 16 injections of neoarspnenamine, a total of 6.28 grams, and 16 injections of thiobismol.

The third course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on December 8, 1936, followed by a 0.45-gram injection on December 15 and 0.6-gram injections on December 12, 22, and 29, 1936, and January 6, 1937. Twenty-four hours after the last injection the patient had a chill, followed in 1 hour by a temperature of 101°. Within 24 hours his temperature was normal and the patient felt well. He recovered in 24 hours.

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Twenty days later he was given a 0.3-gram injection of neoarsphenamine. This injection was followed by a gastro-intestinal reaction and will be described under case 40—1937.

(28—1937.) After exposure to infection this patient developed a lesion on the penis which was positive for *Treponema pallidum*. Antiluetic treatment was instituted and he received the following treatment: From December 1, 1925, to October 7, 1926, 17 injections of neoarsphenamine and 37 injections of mercury; from September 1 to October 28, 1927, 8 injections of neoarsphenamine and 20 mercury inunctions; from February 16, 1928, to December 31, 1929, 38 injections of neoarsphenamine; from March 13 to May 21, 1931, 2 injections of neoarsphenamine and 4 injections of bismuth salicylate. (Amounts of the above treatment were not recorded.)

On October 1, 1936, he received a 0.35-gram injection of neoarsphenamine which resulted in a slight gastro-intestinal reaction. Arsenical treatment was changed to mapharsen. From October 7 to December 3, 1936, he received nine injections of mapharsen, a total of 0.27 gram. On January 28, 1937, he was given a 0.24-gram injection of neoarsphenamine, and 20 minutes later he became nauseated and stuporous and complained of severe pains in the sacral region. Examination showed the patient in semicomatose condition—temperature 97.8°, no pulse in radial artery and no heart sound. He was given 0.5 cc of adrenalin subcutaneously, and in 5 minutes a feeble, rapid (140) easily compressed radial pulse was palpable. Similar doses of adrenalin were repeated in 5, 30, and 35 minute intervals for a total of four injections. Recovery occurred in 5 hours.

(29—1937.) The source and date of infection in this case are unknown. The patient was under treatment in a naval hospital in 1936 when a Kahn blood test was 3-plus on January 22 and 30 and 4-plus on February 13. Due to insufficient evidence a diagnosis of syphilis was not established but antiluetic treatment was instituted. From March 2 to September 1 he received 15 injections of neoarsphenamine, a total of 6.5 grams, and 21 injections of bismuth salicylate.

On March 16, 1937, the patient was given a 0.15-gram injection of neoarsphenamine and 1 hour later complained of weakness, nausea, and vomiting. The nausea and vomiting subsided after a few minutes. Physical examination revealed extreme pallor and prostration. Temperature 101.4°; pulse, 108; and respirations, 24. He was given 0.5 cc of adrenalin, and 15 minutes later 1 gram of sodium thiosulphate intravenously. The following morning the patient felt well except for weakness. His temperature gradually returned to normal. Recovery occurred in 6 days.

(30—1937.) This patient was exposed to infection in December 1936, and 1 month later developed a lesion on the penis which did not heal under local treatment. A diagnosis of syphilis was made on March 14, 1937, because of secondary rash on the body and arms; positive darkfield examinations of a lesion on the penis; and a 4-plus Kahn blood test. A 0.3-gram injection of neoarsphenamine was given on this date followed by 0.6-gram injections on March 18 and 25. Two injections of bismuth salicylate were given as concurrent treatment. Seven hours after the last injection of neoarsphenamine he complained of chills and headache; the eyes were injected; and his temperature was 102.4°. He was given 1 gram of sodium thiosulphate intravenously. The following morning he complained of weakness and the eyes were tinged slightly yellow. All symptoms subsided and his temperature gradually returned to normal. Recovery occurred in 6 days.

(31—1937.) After exposure to infection in December 1936 this patient developed a lesion on the penis which was positive for *Treponema pallidum*. A Kahn blood test was 4-plus. He was given a 0.3-gram injection of neoarsphenamine on March 5, 1937, followed by 0.45-gram injections on March 8, 11, and 15. Three hours

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after the last injection he developed chills and a temperature of 103°, and vomited twice during the next hour. He was given 1-gram intravenous injections of sodium thiosulphate on March 16 and 17. The patient showed rapid improvement after the injections of sodium thiosulphate. Recovery occurred in 3 days.

(32—1937.) One month following exposure to infection on January 3, 1934, this patient developed a lesion on the penis which was positive for *Treponema pallidum*. From February 8, 1934, to February 28, 1935, he received 24 injections of sulpharsphenamine and 34 injections of bismuth salicylate (total amounts not stated).

The third course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on March 16, 1937, followed by 0.6-gram injections on March 23 and 30. Forty-five minutes after the last injection the patient developed nausea, vomiting, headache, chills, and fever. He was given 1 gram of sodium thiosulphate intravenously and his condition improved immediately. Recovery occurred in 24 hours.

(33—1937.) After exposure to infection on April 15, 1937, this patient developed lymphadenopathy and several ulcers on the penis. A Kahn blood test was 4-plus. He was given a 0.3-gram injection of neoarsphenamine on April 27, 1937, followed by 0.45-gram injections on April 20, May 4 and 11. Four hours after the last injection the patient complained of nervousness and restlessness. Examination showed swelling of the lips, injected conjunctiva, and hot and dry skin. Temperature, 104°; pulse, 112; and respirations, 28. The symptoms gradually subsided and he recovered within 36 hours.

(34—1937.) One month following exposure to infection this patient developed a lesion on the penis which was positive for *Treponema pallidum*. From December 11, 1935, to December 21, 1936, he received three courses of an arsenical compound, a total of 14.1 grams, and 4.4 grams of heavy metal compounds as concurrent treatment. (Type of drug and number of injections not recorded.)

The fourth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on March 20, 1937, followed by a 0.6-gram injection on March 27, a 0.15-gram injection on April 3, and a 0.3-gram injection on April 10. Four injections of bismuth salicylate were given as concurrent treatment.

Forty-eight hours after the last injection of neoarsphenamine the patient complained of general malaise, chills, headache, and abdominal soreness. Temperature, 100.4°. Symptoms subsided within 4 days except for a slight rise in temperature during the evenings. Recovery in 7 days.

(35—1937.) This patient was given a diagnosis of syphilis on May 31, 1926. There was no diagnostic evidence in the health record and no record of antiluetic treatment prior to June 17, 1931. From June 17, 1931, to February 27, 1932, he received 16 injections of neoarsphenamine, a total of 9 grams, and 32 injections of bismuth salicylate as concurrent treatment.

After exposure to infection on April 14, 1937, the patient developed a lesion on the penis which was positive for *Treponema pallidum*. Repeated Kahn blood tests were 4-plus. This infection was recorded as the second syphilitic infection. From April 29 to June 24, 1937, he received 8 injections of neoarsphenamine, a total of 4.35 grams, and 4 injections of bismuth salicylate, and from July 2 to October 1, 10 injections of thiobismol.

The fourth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on November 16, 1937, followed by 0.3-gram injections on November 23 and December 28. Five hours after the last injection of neoarsphenamine the patient complained of chills, headache, and slight nausea. The chills persisted for about 40 minutes. Temperature, 104.5°; pulse, 124; and respirations, 26. The ingestion of a large meal after receiving the injection of neoarsphenamine was a contributing factor. One gram of sodium thiosulphate

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was given intravenously and the symptoms gradually subsided. His temperature returned to normal within 5 days. The patient was continued on the sick list under observation and treatment with mapharsen for 12 additional days.

(36—1937.) This patient was infected on May 13, 1932, and 1 month later a lesion developed on the glans penis which was positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

From June 16, 1932, to May 22, 1936, he received 70 injections of neoarsphenamine, 62 injections of bismuth salicylate, and 12 injections of mercury. (Total amount of treatment was not recorded.) From September 4 to November 6, 1936, he was given eight injections of sulpharsphenamine, a total of 1.6 grams, and five injections of bismosol.

The tenth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on March 18, 1937, followed by 14 weekly injections of 0.3 gram each, a total of 4.5 grams. Thirty minutes after the injection given on July 15, 1937, the patient developed nausea, vomiting, and chills, temperature, 103°. The symptoms subsided and his temperature returned to normal within 6 hours.

(37—1937.) Following exposure to infection on July 15, 1937, this patient developed several ulcers on the penis which were positive for *Treponema pallidum*. He was given a 0.3-gram injection of neoarsphenamine on August 29, and a 0.45-gram injection on September 3. Six and one-half hours after the last injection the patient complained of headache, nervousness, chills, and fever. Examination showed flushed skin, temperature 104.8°, pulse 126, and respirations 32. One gram of sodium thiosulphate was given intravenously. All symptoms subsided within 44 hours and the patient was considered recovered.

Arsenical treatment was continued on September 7, 1937, with a 0.45-gram injection of neoarsphenamine. Five and one-half hours after this injection the patient developed a mild arsenical dermatitis reaction from which he recovered in 24 hours. (Case No. 10—1937, U. S. Naval Medical Bulletin, October 1938).

(38—1937.) This patient was exposed to infection on July 6, 1937, and 2 months later a penile lesion developed which was positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

From September 20 to October 19, 1937, he received a total of 2.88 grams of neoarsphenamine and 0.52 gram of bismuth salicylate. The second course of arsenical treatment began with a 0.45-gram injection of neoarsphenamine on October 26, followed by 0.5-gram injections on November 2, 9, and 16. He was also given a 0.13-gram intramuscular injection of bismuth salicylate on November 16. About 5 minutes after the last injection of neoarsphenamine the patient complained of severe pains over the middle of the sacrum. Examination showed profuse perspiration, cold extremities, breathlessness, and rapid pulse. Temperature 103.6°. He was given ⅓ grain of ephedrine hydrochloride by mouth. The attack subsided in about 1 hour, but returned within 7 hours.

November 17: The patient complains of headache, pains in the chest, and abdominal cramps. Temperature, 101°; pulse, 100; and respirations, 20. One gram of sodium thiosulphate was given intravenously.

The patient had marked bilateral adenopathy. The left inguinal lymphogranuloma was incised and drained; RBC, 4,130,000; WBC, 13,950; Hgb, 90 percent; segmented, 75; bands, 6; lymphs, 13; eosins, 3; monos, 3.

Within 5 days the patient had apparently recovered from the reaction. Physical examination was negatve other than marked bilateral adenopathy and he was continued on the sick list under observation and treatment for lymphogranuloma inguinale.

A 0.3-gram injection of neoarsphenamine was given on January 5, 1938, and a 0.45-gram injection on January 11. He received both injections without signs

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or symptoms of further reaction. On January 18 he was given a 0.6-gram injection of neoarsphenamine which resulted immediately in a slight rise in temperature. Neoarsphenamine was discontinued and mapharsen substituted. He received one injection of mapharsen weekly for 4 weeks without signs of further reaction.

The patient was returned to duty 94 days after the onset of the first symptoms.

Sulpharsphenamine.—(39—1937.) The source of infection in this case is unknown. The patient was given a diagnosis of syphilis because of repeated 4-plus Kahn blood tests; a superficial ulcer of the palate characteristic of the mucous patches seen in early syphilis; and distinct, shotty, discrete posterior cervical adenopathy.

From March 10 to April 5, 1934, he received a total of 1.9 grams of arsphenamine; from August 12, 1934, to May 21, 1935, 5.75 grams of neoarsphenamine and 7.41 grams of bismuth salicylate as concurrent treatment.

The fourth course of arsenical treatment began with a 0.3-gram injection of sulpharsphenamine on June 8, 1937, followed by 0.45-gram injections on June 15 and 22. Ten minutes after the last injection the patient suffered from abdominal cramps, followed by nausea, vomiting, and slight diarrhea. He was given 1 cc of adrenalin intravenously and 1 gram of sodium thiosulphate intravenously. Recovery occurred within 24 hours.

Gastro-Intestinal

Neoarsphenamine.—(40—1937.) Two months after repeated exposures to infection this patient developed several lesions on the penis. Repeated darkfield examinations were negative. A Kahn blood test was 4-plus on November 4, 1935. From November 4, 1935, to February 6, 1936, he received 16 injections of neoarsphenamine, a total of 6.28 grams, and 16 injections of thiobismol. The third course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on December 8, 1936, followed by a 0.45-gram injection on December 15, and 0.6-gram injections on December 12, 22, 29, and January 6, 1937. Twenty-four hours after the last injection the patient developed a chill, followed in an hour by a temperature of 101°. Within 24 hours the temperature had returned to normal and the patient felt well. About 3 weeks later arsencial treatment was resumed and a 0.3-gram injection of neoarsphenamine was administered on January 26. About 1 hour after the injection the patient complained of abdominal cramps, chills, severe generalized aching, and slight diarrhea. Temperature, 100.8°; pulse, 110; and respirations, 18. He was given 1 gram of sodium thiosulphate intravenously. The symptoms disappeared and he recovered within 24 hours.

(41—1937.) Antiluetic treatment was instituted in this case because of repeated 4-plus Kahn blood tests. The patient denied venereal history, and a diagnosis of syphilis was not made, because there was no evidence or history of syphilitic infection. From June 14 to August 9, 1932, he received 7 injections of neoarsphenamine, a total of 4.1 grams, and 10 injections of bismosol; from April 4 to June 7, 1933, 8 injections of neoarsphenamine, a total of 4.8 grams, and 12 injections of bismosol; and from August 24 to October 13, 1933, 12 injections of bismosol.

The third course of arsenical treatment began with a 0.225-gram injection of neoarsphenamine on January 26, 1937, followed by 0.45-gram injections on February 2 and 9. Immediately following the last injection the patient became nauseated and vomited, followed by abdominal cramps and diarrhea. Examination revealed the face flushed, conjunctiva grossly injected, and mild chemosis. The patient complained of severe pains in the legs and about the coccyx. About 30 minutes after the injection of neoarsphenamine he developed a chill and a

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temperature of 99.6°. One gram of sodium thiosulphate was given intravenously. The following morning he complained of feeling weak; the face was slightly flushed, and the conjunctiva was slightly swollen. Recovery occurred in 2 days.

Jarisch Herxheimer

(42—1937.) After exposure to infection on December 13, 1936, this patient developed a lesion on the penis which healed under local treatment. He was given a diagnosis of syphilis, because of secondary skin eruption, 4-plus Kahn blood test, and history of a penile lesion. He was given a 0.2-gram injection of neoarsphenamine on February 5, 1937, and 9 hours after the injection the patient developed chills, fever, a bright red rash, and a temperature of 104°. He was given 1 gram of sodium thiosulphate intravenously. The rash subsided and his temperature returned to normal within 7 hours.

Liver Damage

(43—1937.) After exposure to infection on March 6, 1937, this patient developed a penile lesion which was positive for *Treponema pallidum*. Arsenical treatment was instituted, and he received 0.3-gram injections of neoarsphenamine on March 13 and 16. The patient was admitted to the sick list on March 24 with a diagnosis of mumps. During his convalescence he was given 0.4-gram injections of arsphenamine on April 2 and 8 and a 0.6-gram injection of neoarsphenamine on April 15. Six hours after the last injection the patient developed headache, chills, and a temperature of 103.4°. He was given 1 gram of sodium thiosulphate intravenously. The patient's temperature was normal the following morning and he showed improvement during the next 5 days. Other than a slight rise in temperature daily, examination was essentially negative.

April 23: Examination showed an icteric tint to the skin and sclera, temperature 101.8°. Urinalysis showed a slight trace of albumin and occasional red and white cells.

April 29: His temperature has gradually decreased and the jaundice appears to be catarrhal and subsiding. Urine is very dark and shows slight trace of albumin.

May 4: The patient appears to show no improvement, temperature 102.4°. Due to the chronic jaundiced condition and long illness, it is believed that he has an acute yellow atrophy of the liver due to arsphenamine and neoarsphenamine poisoning. The patient has been able to take food and fluids fairly well although he sleeps most of the time. Examination shows no definite alteration in the size of the liver. He was given 1 gram of sodium thiosulphate intravenously.

May 8: The patient is gradually becoming more toxic and is losing weight. His temperature ranges around 103° daily. There is a marked icteric tint to the skin, sores on the lips, and a foul odor to the breath. RBC, 2,520,000; HGB, 60 percent; WBC, 1,800; bands, 26; segmented, 43; lymphs, 16; monos, 11; juveniles, 3; basophiles, 1.

June 9: The patient has shown a gradual improvement on symptomatic treatment. His temperature has been normal for 6 days and he has been up and about. Physical examination revealed the liver normal and the jaundice clearing. It is believed that the liver damage is temporary and probably due to neoarsphenamine.

The patient gradually gained in strength and weight and he was returned to duty 143 days after onset of the first symptoms.

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Blood Dyscrasias

(44—1937.) The source and date of infection in this case is unknown. The patient was given a diagnosis of syphilis because of repeated 4-plus Kahn blood tests and generalized adenopathy.

From September 19 to October 1, 1936, he received three injections of arsphenamine, a total of 1.1 grams. From October 10 to November 19 he received seven injections of neoarsphenamine, a total of 4.2 grams, and from November 8 to January 19, 1937, he was given nine injections of bismuth salicylate.

The second course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on January 16, followed by a 0.45-gram injection on January 23 and 0.6-gram injections on January 30 and February 6. One and one-half hours after the last injection the patient complained of severe headache, chills, and fever. About 3 hours after the injection a purpuric rash appeared over the shoulders, chest, arms, and thighs. The headache, chills, and fever subsided but the rash remained until February 9, at which time examination showed numerous small to medium intracutaneous purpuric blotches of livid coloration. The skin bruised easily and there were several areas of ecchymotic discoloration surrounding the more livid purpuric blotches. He was given 1 gram of sodium thiosulphate intravenously on February 9 and 11 which hastened clearance of the rash. Recovery occurred in 9 days.

(45—1937.) Two months after exposure this patient developed a penile lesion which was positive for *Treponema pallidum*.

From March 7 to September 8, 1936, he received 16 injections of neoarsphenamine, a total of 7.5 grams, and 23 injections of bismuth salicylate, and from December 1 to December 29, 4 injections of neoarsphenamine, a total of 1.75 grams. Immediately following the last injection the patient developed a mild blood dyscrasias reaction. Recovery in 4 days. (Case No. 71—1936, U. S. Naval Medical Bulletin, January 1938).

The fourth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on March 30, 1937, followed by a 0.45-gram injection on April 6 and a 0.5-gram injection on April 14. Three hours after the last injection the patient developed several small purpuric spots on the legs and slight bleeding from one spot on the upper gum. RBC, 4,522,000; WBC, 6,100; segmented, 50; lymphs, 47; bands, 2; transitionals, 1. The purpuric spots disappeared rapidly following the administration of 1 grain of sodium thiosulphate intravenously. Recovery occurred in 3 days.

(46—1937.) The source and date of infection in this case is unknown. The patient was given a diagnosis of syphilis because of repeated 4-plus blood tests and general alopecia.

From September 11, 1933, to September 18, 1934, he received 27 injections of neoarsphenamine (total amount not recorded) and 27 injections of bismuth salicylate.

The fourth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on April 17, 1937, followed by a 0.45-gram injection on April 25 and 0.5-gram injections on May 1 and 15. Two days after the last injection examination revealed a scattered purpuric petechial rash on the trunk, arms, thighs, and legs and several petechial hemorrhages under the mucous membrane of the tongue. The rash continued for 2 days, after which the hemorrhages showed signs of absorbing. Areas of discoloration remained for 7 days.

Optic Neuritis

Tryparsamide.—(47—1937.) This patient (supernumerary, veteran) was admitted to a naval hospital on June 22, 1937, with a diagnosis of tabes dorsalis.

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The patient appeared acutely ill and complained of abdominal pains, nausea, and weakness. Physical examination revealed an emaciated, elderly, edentulous male; conjunctiva injected. The source and date of syphilitic infection is unknown. He states that he received 10 injections in the arm and 25 injections in the hip during the years 1934 and 1935. The type of drug and amount given was not known. From May 27, 1936, to June 26, 1937, he was given nine injections of bismuth salicylate.

June 29: During the night a gastric crisis occurred, followed by nausea and vomiting after eating breakfast. All symptoms subsided within 3 hours and he was able to eat a good lunch and retain it. The same symptoms and condition occurred the following day.

July 6: The patient's condition is improving and he has no complaint. He was given an injection of 1.5 grams of tryparsamide, followed by an injection of 3 grams on July 13. On July 15 the patient returned from liberty acutely ill complaining of abdominal pains, nausea, and weakness. The symptoms subsided the following day.

July 20: The patient was given an injection of 3 grams of tryparsamide and fever treatment lasting 6 hours, with temperature from 105° to 106°, rectal.

July 27: The patient was given 3 grams of tryparsamide intravenously.

July 29: He was given the second fever treatment with temperature from 105° to 106°.

August 3: The patient was given a 3-gram injection of tryparsamide and 4 hours later he complained of blurred vision. Eye examination: Visual fields: Age 43. VOD 20/40–2; VOS 20/20; pupils pinhead size and immobile. Beginning optic nerve atrophy, both eyes. Treatment with tryparsamide was discontinued and the patient gradually showed marked improvement subjectively. He was discharged from the hospital at his own request 28 days after the last injection of tryparsamide.

HEMORRHAGIC ENCEPHALITIS

Neoarsphenamine.—(48—1937.) The source and date of infection in this case is unknown. Several admissions to the sick list with a diagnosis of bubo, inguinal (nonvenereal) had been recorded for this patient. Following admission on September 2, 1935, repeated Kahn blood tests were 4-plus. There was no evidence of a primary lesion or history of infection.

Antiluetic treatment was instituted and from September 21, 1935, to December 5, 1936, he received 30 injections of neoarsphenamine, a total of 13 grams, and 44 injections of bismuth salicylate.

The fifth course of arsenical treatment began on June 24, 1937, with a 0.3-gram injection of neoarsphenamine, followed by nine weekly injections, 0.45 gram each, a total of 4.35 grams. Twenty-four hours after the injection given on August 26 the patient complained of headache and general malaise. Physical examination was essentially negative other than slightly injected conjunctivae and a temperature of 102.4°, pulse 120, and respirations 22. All of the symptoms subsided except slight headache and septic temperature.

On August 30, 4 days after the last injection of neoarsphenamine, the patient became nauseated and vomited several times. The following morning he complained of stiffness of the neck, headache, and nausea. The headache and stiffness of the neck grew progressively worse. Examination showed the fauces and pharynx to be slightly reddened, the eyeballs sore on pressure, and the neck sore and stiff on flexion. Urine showed 3-plus albumin. WBC, 5,300; bands, 37; segmented, 30; lymphs, 16; and monos 17. It is believed that the patient's condition is due to meningeal irritation or mild encephalitis from neoarsphenamine poisoning. One-gram injections of sodium thiosulphate were given intravenously on August 31 and September 1.

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Intermittently during the next 2 weeks of treatment the patient complained of slight headache. Temperature ranged around 99.5°. He was returned to duty after 28 days on the sick list.

Case History of Fatal Reaction

(49—1937.) This patient was exposed to infection on January 6, 1923, and 1 month later a primary lesion developed on the glans penis. A Wassermann blood reaction was 4-plus.

Antiluetic treatment was instituted and he received the following treatment: From February 9, 1923, to December 24, 1924, 26 injections of neoarsphenamine and 20 injections of mercury; from April 7 to May 29, 1925, 8 injections of sulpharsphenamine; from February 12, 1927, to March 20, 1928, 17 injections of neoarsphenamine; from October 13 to December 20, 1932, 8 injections of neoarsphenamine and 10 injections of bismuth salicylate; from February 20 to April 29, 1936, 8 injections of neoarsphenamine and 8 injections of bismosol; from May 19 to November 3, 1936, 13 injections of tryparsamide and 16 injections of bismosol; from April 27 to July 13, 1937, 8 injections of bismuth salicylate. (Total amount of the above treatment not recorded.)

The ninth course of arsenical treatment began with a 0.3-gram injection of neoarsphenamine on July 20, 1937, followed by a 0.45-gram injection on July 27, 0.5-gram injection on August 3 and 10, and 0.6-gram injections on August 24, 31, September 8, 14, and 22. As concurrent treatment he was given 0.13-gram injections of bismuth salicylate on September 8, 14, and 22, 1937.

On September 25, 1937, 72 hours after the last injection of neoarsphenamine the patient complained of malaise, headache, generalized aching throughout the body, supraorbital pain, and weakness. Physical examination essentially negative except for hot flushed face and body; temperature 101.8°, pulse 98, and respirations 24. WBC, 4,700; bands, 11; segmented, 67; lymphs, 16; eosins, 2; and monos, 2. The patient was admitted to the sick list and given routine fever treatment.

September 26: The patient complained of nausea and several hours later vomited about 50 cc of yellowish-colored fluid. Temperature, 102°; pulse, 100; and respirations, 28. Patient was unable to tolerate food.

September 27: Temperature normal. WBC, 4,050; bands, 10; segmented, 56; lymphs, 30; monos, 4. About noon the patient very suddenly developed anarthria, listlessness, mild ataxia with pass pointing and inability to do heel-tibia maneuver. Physical examination: Rhomberg positive, tendon deep and superficial reflexes hyperactive. He was very restless and his condition became progressively worse. Constant watch was maintained during the night to keep the patient in bed.

September 28: The patient is worse. Diagnosis changed to diagnosis undetermined (hemorrhage, pons) because of complications. Nearly complete anarthria. Difficulty in arousing the patient sufficiently to allow examination with immediate return to lethargic state after any manipulation. Partial paralysis of the seventh and ninth cranial nerves, left side, with pharyngeal reflex absent. Cough reflex diminished with the patient choking upon swallowing water. There is a deviation to the left when tongue is protruded and a difficulty in returning the tongue to the mouth. The eyes react to light but not accommodation, with some irregularity in the pupils. No nystagmus noted, but due to poor cooperation of patient, reliability is doubtful. Tendon reflexes exaggerated, Babinski positive. Marked ataxia with coarse tremor amounting to almost clonic spasm at times, particularly in the extremities. At 5 p. m. it was noted that patient had spasticity on lateral rotation of right arm. Patient unable to void, was catheterized and

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600 cc of urine obtained, which was negative for albumin and sugar. His condition is growing progressively more critical.

September 29: The patient presents a picture of generalized spastic paraplegia. Temperature, 99.4° (axillary); pulse, 96; and respiration, 25. The upper and lower extremities are spastic and movement can be initiated but not completed; the seventh and ninth cranial nerves, left side, are partially paralyzed; on protrusion of the tongue deviation is to the left; the left side of the face is flattened; and complete anarthria and aphasia are present. Tendon reflexes are increased; Kernig and Brudzinski are negative, and Babinski is positive bilateral. Athetoid movements of the fingers and forearms are present. Swallowing is difficult. The patient can be aroused but lapses into semistupor immediately. Temperature, 101° (axillary).

Blood: RBC, 4,760,000; Hgb., 90%; WBC, 5,600; segmented, 62; bands, 6; lymphs, 2; monos, 4.

Urine: Color, hazy, amber; reaction, acid; specific gravity, 1.018; albumin, 3 plus; very large amount of mucus; 8 to 10 WBC per HPF., 13 to 14 RBC per HPF.

Spinal fluid: Cells, 47 per cubic millimeter (blood). Globulin: Increase (one) 1 plus (blood). Lange curve 0000000000. Adrenalin, 1 cc, was given intravenously. No untoward reaction.

3 p. m.—One gram of sodium thiosulphate was given intravenously, followed by 2 cc of adrenalin, intravenously.

7 p. m.—Patient's condition unchanged. Adrenalin, 2 cc, given subcutaneously and 1,500 cc of saline by hypodermoclysis.

September 30: The patient's condition is worse with evidence of increasing moisture in the lungs, temperature 104° (axillary). He was given 1,500 cc of saline by hypodermoclysis. Physical and neurological findings and clinical course indicate encephalitis, acute hemorrhagic, toxic, presumably due to arsenic poisoning.

7 p. m.—Patient moribund. Pulse rapid, weak, and thready. Cheyne-Stokes respiration. Temperature 106° (axillary).

He died at 8:34 p. m., 6 days after onset of symptoms.

Autopsy findings

General: The body is that of a white male about 39 years of age, showing good development and nutrition, no gross abnormalities and beginning dependent lividity. Rigor mortis has not started. Eyes show pupils in mild dilation.

Brain: Meninges were not notable except for a thickening of the pia-arachnoid on the base of the brain stem. The brain was diffusely pinkish in color over the cortex. There was marked vascular congestion and the brain was definitely wet. No gross hemorrhage or thrombosis was seen. Each hemisphere independently showed an area of punctate hemorrhage with necrosis of the brain substance in the region of each internal capsule.

Thorax: The heart was stopped in systole. Areas of scarring were present in the myocardium. Valves appeared to be in good condition. Coronaries were thickened. The aorta showed nothing notable.

Lungs: The lungs showed the presence of bronchopneumonia.

Abdomen: The gastro-intestinal tract was not notable.

Liver: Grossly negative.

Kidneys: Parenchyma showed indistinct markings of vascular engorgement. There were adhesions about the left kidney and the capsule was adherent.

Bladder: The bladder was mildly distended.

Extremities: Not notable.

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Pathological diagnosis

1. Encephalitis, acute, hemorrhagic.
2. Wet brain.
3. Meningo-encephalitis, syphilitic (old).
4. Bronchopneumonia (terminal).
5. Cloudy swelling of visceral organs.
6. Myocardial degeneration.

FOOD POISONING

AT THE UNITED STATES NAVAL TRAINING STATION, SAN DIEGO, CALIF.

By Capt. G. E. Thomas, Medical Corps, United States Navy

Creamed Chicken

Thirty-one cases of food poisoning occurred on this station on July 13, 1938. Forty-two recruits arrived about 1:30 p. m., from various recruiting stations. They had not eaten since early morning and were immediately fed.

The meal consisted of creamed chicken, potatoes, cucumbers, lettuce salad, bread, butter, and ice cream. It was served in one of the north unit mess halls from mess gear regularly employed for feeding the men of this unit. All articles of this meal, with the exception of the creamed chicken, were prepared at one time and under unvarying circumstances for the entire north unit; the menu for the noon-day meal for the personnel of the station included chicken turn-overs which were eaten by all the personnel of the station. The newly arrived recruits, because of a shortage of chicken turn-overs, were given creamed chicken.

To exclude from consideration the possibility of preceding meals harboring the causative agent of this outbreak of food poisoning, the previous meals of the group of new recruits will be discussed. The menus for breakfast varied as the men were reporting from three separate recruiting stations and ate breakfast in three different places as detailed in the following table:

Number of men	Number of men eventually sick	Place where breakfast was eaten	Constituents of breakfast
10	6	Union Pacific train	Ham, eggs, white bread, coffee, milk.
29	20	Santa Fe station, Los Angeles, Calif.	Cantaloupe, cooked cereal, toast, bacon, eggs, coffee, milk.
3	2	Southern Pacific train	Breakfast a la carte; varied considerably; bacon, ham, griddle cakes, toast, eggs, coffee.
31[1]	3	North unit, training station, San Diego.	Scheduled breakfast for training station.

[1] These men, because of their occupation, were late for regular noon-day mess and ate with the newly arrived recruits.

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The meals of the previous 2 days were eaten at numerous individual places in various parts of the country, and, therefore, consisted of widely different articles of food from dissimilar sources.

The 42 recruits, and the 3 men from the north unit of this station, were fed between the hours of 1 p. m. and 1:30 p. m. Seven of the forty-two ate all of the constituents of the meal except the chicken; these men did not present symptoms of food poisoning. Of the remaining 35, 7 ate all of the lunch including chicken and were not sick; of these, 3 stated that they had "only one or two bites of the chicken." The remaining 28 men and the 3 already enrolled on the station had creamed chicken and all were ill. No one was ill who had not consumed some of the creamed chicken.

The first indications of illness appeared between the hours of 3 p. m. and 4 p. m., an incubation period of 2 to 3 hours following the noon-day meal. All patients were young men, previously in robust health, who recently had not been subject to unusual physical strain. In no instance could the symptoms and signs be ascribed to a relapse or recurrence of any disorder.

Prodromata were absent. The onset was explosive, the first symptom being sharp, intermittent, cramping, generalized abdominal pain. This was almost immediately followed by frequent evacuation of watery stools, severe nausea and vomiting, moderate pallor, profuse cold perspiration, and a remarkable prostration. In no case was abdominal distention detected. Distinct chills and sensation of chilliness were complained of in the majority of cases. Early, oral temperature was definitely below average, ranging from 97° to 98.2°, rising as symptoms and signs subsided, up to, but not above, 100°. Streaks of blood in both vomitus and stools were seen in about five cases from the more severely ill groups. General aching pains and soreness were not present; in only two cases, both severely ill, were cramping pains in the muscles of the lower extremities complained of and then only after the severe vomiting began to subside (chloride depletion). Nervous manifestations and ocular signs did not occur except in one instance in which the patient was quite prostrated following severe and protracted vomiting and diarrhoea. With the subsidence of the latter, he complained of diplopia which disappeared after 3 or 4 hours and was, therefore, ascribed to exhaustion. In general, the pupils were slightly dilated, equal and reacted promptly to light and accommodation. The pulse rates were slightly to moderately elevated ranging from 80 to 100 per minute. No abnormal features of respiration were noted. Skin eruptions of discoloration were not detected.

Blood counts were made and revealed the following: haemoglobin estimations (Talquist) between 90 and 100 percent; erythrocyte counts

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ranging from 5,240,000 to 5,780,000; white blood counts averaging 16,130, and ranging from 10,100 to 31,000, with a decided shift to the left, the band cells being increased from 11 to 35 percent of the total white cell count, and in two instances 1 and 3 percent of juvenile cells were found. No other abnormal features were seen in the blood.

Urinalysis showed an average specific gravity of 1.022 and moderate turbidity of every specimen. All specimens were negative for blood, albumin, sugar, and casts. Cultures of the urine specimens were not made.

Specimens of stools and vomitus sent to the naval hospital at San Diego for bacteriological study were reported as follows: "Feces and vomitus cultured and plated. Only organisms recovered were the usual nonpathogenic inhabitants of the gastro-intestinal tract."

All of the ascertainable facts concerning the food consumed at the noon-day meal of July 13, 1938, are now presented. Of all the food served to both the enlisted personnel of the north unit and the newly arrived recruits, namely, chicken, potatoes, cucumbers, lettuce salad, bread, butter, and ice cream, the chicken alone differed in details of preparation. All of the chicken consumed on that day had been purchased on one contract, shipped in one lot under similar conditions, and stored in a refrigerator until ready for preparation and consumption. All chickens prepared for dinner on July 13 were removed from the refrigerator July 12, late in the morning, boiled from about 2 p. m. to 4 p. m. that afternoon, set aside at room temperature to cool, and then deboned, the latter process being completed at about 7:30 p. m. The boned chicken was then taken to the bakery where it remained throughout the night at room temperature in rustless steel containers. At about 9 a. m. July 13 the greater portion of this chicken was placed in jackets of dough (turn-overs) and baked for about 2½ hours; these were then served hot. All of the turn-overs were consumed. The remainder of the chicken was allowed to stand at room temperature. On notification to prepare a meal for the newly arrived recruits at 1 p. m. July 13, this remaining boned chicken was creamed, then heated to make it more palatable, but not boiled or baked, and served while warm in cleaned and dried stainless metal trays. No canned food was used at this meal.

None of the suspected food, namely creamed chicken, was obtainable for examination; all of it, according to the mess attendants, had been consumed.

Conclusions

(1) An outbreak of food poisoning, occurring in 31 out of a possible 45 individuals on July 13, 1938, resulted from the consumption by these individuals of the noon-day meal served on this station.

(2) The most likely source of the poisoning was the creamed chicken, contaminated either during or after boning.

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(3) The contaminating agent was an organism or toxin produced by an organism rather than a chemical.

(4) The onset of the illness, lack of prodromata, short incubation period, signs, and symptoms, and the duration of the illness are most compatible with an enterotoxic staphylococcus food infection.

(5) Laboratory findings were inconclusive as to the specific organism producing the gastro-enteric symptoms.

Ham

An outbreak of 540 cases of food poisoning occurred on this station on July 23, 1938. At the time of the outbreak, about 1:30 p. m., the personnel of the station were on a liberty status, in consequence of which, some were with their families in their respective homes, some were bathing on one of the near-by public beaches, others were in the city of San Diego, and a large group remained on the station. Throughout the morning prior to the hour of the outbreak these men were variously occupied among the many activities in the north unit.

The food eaten at the noon-day meal on July 23, 1938, was suspected of containing the causative agent of the poisoning for the following reasons:

(1) No member of the south unit was ill despite the fact that the breakfast of that day and the meals of the previous 2 days were identical in kind and preparation with those of the north unit.

(2) Approximately 20 individuals of the north unit, returning from town in the evening on the day of the outbreak and having had no gastro-intestinal complaints suggestive of food poisoning, were interviewed. It was learned that these men had eaten all meals on the station for the past 3 days up to and including breakfast on the day of the outbreak. At about 11 a. m. these men left the station and went into the city of San Diego where they purchased and ate their noon-day meal.

(3) All persons who became ill partook of the Saturday noon meal.

Evidence at least apparently incriminating boiled ham, the meat constituent of the noon-day meal in question, is as follows:

(1) All persons not partaking of the ham prepared in the north unit remained well.

(2) Several individuals ate one or more sandwiches containing the ham and ate none of the other food; all of these became ill to a lesser or greater extent, depending on the amount of ham consumed.

(3) Several bed-patients in the dispensary ward afflicted with catarrhal fever, tonsillitis, etc. were on a soft diet which included practically all the constituents of the noon-day meal except the boiled ham; none of these patients presented signs or symptoms of food poisoning.

With the exception of the noon meal on July 23, meals served on July 21, 22, and 23, were identical for the north unit and the south unit in articles of food and mode of preparation.

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Menus of the meals served in the north unit within 48 hours of the outbreak of food poisoning consisted of the following:

Day	Breakfast	Dinner	Supper
July 21, 1938	Tomato juice cocktail, prepared cereal, fresh milk, sugar, fried pork sausage, brown gravy, hash-brown potatoes, Jenny Linds, bread, butter, coffee.	Vegetable soup, crackers, fried pork chops, brown gravy, mashed potatoes, fresh string beans, hot apple sauce, cole slaw, hot dressing, cherry pie, bread, butter, lemonade.	Boiled corn beef, cabbage, potatoes, carrots, corn on cob, chilled whole tomatoes, chocolate cake, bread, butter, coffee.
July 22, 1938	Chilled fresh fruit, corn flakes, milk, sugar, scrambled eggs, fried diced potatoes, iced coffee cake, bread, butter.	Fish chowder, crackers, grilled fish, sliced lemon, mashed potatoes, stewed tomatoes, combination salad, banana cream pie, bread, butter, lemonade.	Steamed frankfurters, horse radish, lyonnaise potatoes, boiled sauerkraut, vegetable salad, cottage pudding and sauce, bread, butter, tea.
July 23, 1938	Chilled fresh fruit, prepared cereal, milk, sugar, copper baked beans, tomato catsup, hot corn bread, bread, butter, coffee.	Bean soup, crackers, boiled ham, cabbage, potatoes, carrot and apple salad, sour pickles, iced marble cake, bread, butter, iced tea.	

First indications of illness appeared from 2 to 3 hours after the noon-day meal. This incubation period prevailed almost without exception. About 50 individuals ate the ham without becoming ill. Some of these had eaten only very small portions of the ham, while others ate the entire portion served to them. At least three of those who had eaten the ham, learning at the onset of the outbreak and nature of the illness, induced vomiting or applied to the dispensary for a dose of cathartic (magnesium sulphate).

Prior to the onset of gastro-intestinal symptoms these individuals enjoyed good health. The outbreak, therefore, could not be ascribed to a relapse or a recurrence of any other previous disorder. The onset was explosive. Prodromata were absent. The first indication of illness was a mild cramp-like generalized abdominal pain, followed in a few minutes by an exacerbation of the abdominal pain, severe and distressing diarrhoea, marked nausea and frequent forceful vomiting. Salivation, except during nausea, was not excessive. Early the vomitus consisted of undigested food and large quantities of watery liquid with no evidence of blood. Within a short period the vomitus decreased in quantity, and in approximately six instances it contained gross blood. Hematemesis of serious proportions was not noted. Following this episode, retching became violent and continued until the patient was forced to swallow a liberal volume of tap water or a weak solution of sodium bicarbonate. After an almost immediate emesis, retching subsided to a marked extent, but the nausea persisted and vomiting occurred at intervals of every ½ to 1 hour for 4 to 5 hours.

Diarrhoea occurred in every case, coming on at the same time or shortly preceding the emesis. The stool at first was of the normal color, watery in consistency, and expelled with great force. Within

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an hour after the onset the feces became gray or yellowish-gray in color and contained a moderate amount of mucus. In about 25 cases the stools were streaked with blood; in one instance about one ounce of blood was expelled. Tenesmus was not an outstanding symptom in the majority of patients. The diarrhoea lasted from 10 hours to 2 days after the onset of illness, diminishing in frequency as time went on, the stools finally assuming normal physical characteristics. With the subsidence of the diarrhoea, abdominal pains quickly diminished and disappeared.

Prostration was a remarkable symptom in all patients, and appeared out of proportion to the remainder of symptoms; it made its appearance early, and began to subside rapidly when vomiting and diarrhoea decreased. Cold perspiration, associated with a sensation of chilliness was present in the majority of instances. The temperature shortly after the onset was quite definitely below average, ranging from 96.4° to 98.2°; with the subsidence of symptoms, the replenishment of fluids, and rest, the temperature returned to normal, and in the majority of instances was slightly elevated, not exceeding 100° orally. In those cases in which vomiting or diarrhoea were very severe, muscular cramps, particularly of the thighs and legs, but also of the back and abdomen, became quite marked; in all cases, administration of adequate quantities of sodium chloride by mouth resulted in the disappearance of this disagreeable symptom. The pulse was slightly to moderately increased, from 80 to 100 per minute, later returning to normal. Respirations were not remarkably affected. Some generalized pallor was noted early in the disease. Mild generalized abdominal tenderness was common and persisted for from 12 to 24 hours after the onset. Urination was suppressed to such an extent early in the illness that specimens desired for analysis could not be obtained; gradually, it reestablished itself. No abnormal neurological signs were elicited. Except for the behavior incident to the pain and discomfort, no abnormal mental features were observed. Symptoms and signs gradually disappeared in 6 to 15 hours after the onset in the majority of cases, and were completely gone after 24 hours except for mild to moderate general weakness. Skin eruptions or discolorations were not observed at any time.

Blood examination revealed a slight to moderate rise in the erythrocytes, ranging from 5,100,000 to 5,850,000. Hemoglobin content was within normal limits (Talquist). The number of leukocytes varied from 7,650 to 19,000, the average being 12,000. The differential white blood cell count showed a slight to moderate increase in the polymorphonuclear leukocytes with a decided shift to the left, the average number of band cells being 25 percent of the total white count. No other abnormalities were noted.

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Urinalysis showed a dark amber, cloudy to turbid urine with an average specific gravity of 1.024. In one instance a trace of albumin was found. No sugar, casts, or blood were detected. Cultures from urines were not made.

Bacteriological examinations of the stools and vomitus were made in various laboratories and reports obtained were as follows:

(1) Naval hospital, San Diego, Calif.:

Cultures from one specimen of vomitus shows *Salmonella suipestifer*. All other specimens, including feces, were negative for pathogenic organisms. By direct communication with the physician in charge of the laboratory, it was learned that a staphylococcus was also isolated from the vomitus, but further cultural work other than recognition of the type of organism was not performed.

(2) Zoological laboratory, Balboa Park, San Diego, Calif.:

Stool.—Alcaligenes recti.
Vomitus.—Salmonella suipestifer-like organisms.

(3) Pathological laboratory, Department of Health, San Diego, Calif.:

Vomitus and feces are negative for pathogenic organisms.

All articles of food served at the noon-day meal on July 23 were similar in kind and quality in both units; all, with the exception of the ham, were prepared similarly in every respect. The smoked whole hams intended for consumption by the personnel of the station on that day had been purchased on one contract, shipped and delivered under the usual proper conditions, and stored in a store room prior to consumption. The meat was then prepared as follows in the two units:

(1) NORTH UNIT.—The hams were boiled until tender, the latter point being reached about 5 p. m., July 22, 1938. Deboning began about 2½ hours later and was completed between 10:30 and 11 p. m., July 22, 1938. In the process of removing the bones the hams came into intimate contact with the hands of one individual. The hams were then placed into two large stainless steel containers; the latter were allowed to rest on top of a galley range. The range was not in use, but its pilot light over which the containers with meat rested was burning, and therefore furnished a small amount of heat. The hams remained here until 8 a. m., July 23, 1938, at which time they were removed and sliced by an electrically driven slicing machine. From that time on the meat was kept at room temperature until distribution at lunch time, 11:50 a. m., July 23, 1938. The interval of time, therefore, from the time the hams cooled after boiling until time of distribution was approximately 18 hours.

(2) SOUTH UNIT.—Cooking of the hams began at noon, July 22, 1938, and continued until 4 p. m. of that day. They were then placed in their containers on the floor of the butcher shop, at room temperature, and were allowed to remain there until about 4 a. m. July 23, 1938, at which time they were deboned. Immediately afterward they were sliced. To give the meat additional flavor the cooks baked it from 9 a. m., until noon of July 23, 1938, and then distributed it while it was hot. In this unit, the cooking, boning, slicing, and baking were done by individuals other than those of the north unit.

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During the process of deboning the hams no spoilage or other peculiarity was noted. The removed ham bones were carefully examined on the morning of July 24, 1938, and none showed evidence of decomposition, decay, or infection, either of the bone itself or of the meat attached thereto. A boiled unboned ham was liberally sampled by the senior medical officer without producing any untoward symptoms.

Samples of all the food served at the noon meal of July 23, 1938, except the bean soup and iced tea which were not available, were obtained and sent to laboratories for bacteriological examination. It is important at this point to mention that the boiled whole potato available for bacteriological study was found in a tray resting on several pieces of the suspected ham; likewise, that several individuals had eaten potatoes without ham during the meal under discussion and remained well. Reports of the food analyses were as follows:

(1) Naval hospital, San Diego, Calif.:

Salmonella suipestifer isolated from ham specimen submitted July 25, 1938. All other specimens of food submitted on that day negative for pathogenic organisms. (Communication with the physician in charge of laboratories revealed that a strain of staphylococci was also present, but no further differentiation was attempted.)

(2) Zoological laboratory, Balboa Park, San Diego, Calif.:

Ham.—Staphylococcus albus with a four plus Stone's reaction. *Bacterium neopolitanum* and *Proteus mirabilis* also found.

Potato.—Staphylococcus albus with a four plus Stone's reaction. *Proteus vulgaris* also present.

Carrot.—Apple salad: *Alcaligenes recti.*

Pickle.—Staphylococcus salivarius, Stone's reaction negative. *Staphylococcus candidus*, Stone's reaction negative.

(3) Pathological laboratory, Department of Health, San Diego, Calif.:

Ham.—Staphylococcus albus.

Potato.—Staphylococcus albus and *Proteus vulgaris.*

We believe the staphylococcus to be the cause of the food poisoning; all other food specimens submitted were negative for pathogenic organisms.

(4) United States Department of Agriculture, Bureau of Animal Industry:

Ham.—The series of cultures made indicate that the product contains practically a pure strain of staphylococcus of the albus type. We injected a guinea pig and a rabbit intraperitoneally and both animals are seriously ill. The remainder of ham was fed to a cat; this resulted in the cat's vomiting and retching. (Communication with a representative of the Bureau of Animal Industry who made the above report, stated that specimens of the ham sent to their laboratories for toxicologic studies were reported as negative for any of the metallic poisons.)

A remnant of the suspected ham and cultures of staphylococci isolated from the ham have been subjected to further animal feeding

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tests. These tests showed that the bacteria-free filtrate of the cultures fed to kittens produced symptoms and signs typical of food poisoning.

Attention is called to the outbreak of food poisoning on this station July 13, 1938. The mode of preparation of the suspected foods in both epidemics was very similar. The incubation period, onset and clinical course in both instances were alike. Lack of prolonged illness, fatalities, complications, and residua marked both outbreaks. The suspected food in each instance was handled (deboned) by the **same individual.**

Extensive and thorough laboratory and clinical examinations performed at the naval hospital, San Diego, on this individual who deboned the suspected meat disclosed no evidence that he harbored any foci of pathogenic organisms.

Conclusions

(1) Diagnosis of FOOD POISONING on the 540 men afflicted with gastro-intestinal symptoms July 23, 1938, on this station is justified.

(2) The cause of the outbreak of food poisoning is ascribed to the noon-day meal of July 23, 1938.

(3) The contaminated food of that meal was the ham, prepared, served, and eaten in the north unit.

(4) Contamination of the ham occurred either during or after deboning, more likely the former.

(5) The contaminant was an organism or a toxin produced by a living organism rather than a chemical introduced as such into the food.

(6) In view of the fact that only one laboratory reported the presence of *Salmonella suipestifer* in the suspected ham whereas all the laboratories proved the presence of staphylococcus in that article of food, and two laboratories proved that the latter organism was definitely toxic to laboratory animals, and in one instance a strongly positive Stone's reaction was obtained with the isolated staphylococci, the organism invading the food and producing the symptoms of food poisoning was an enterotoxic staphylococcus.

(7) The presence of staphylococci giving a four plus Stone's reaction in the potato is felt to be a contamination from the ham.

(8) The mode of preparing the ham in the north unit of this station was basically faulty and provided the means for bacterial contamination and later rapid growth of the contaminating organisms.

(9) The causative organism in the outbreak of food poisoning occurring on this station July 13, 1938, is similar to the organism producing the epidemic of food poisoning on this station July 23, 1938.

(10) The outbreaks of food poisoning on July 13, 1938, and July 23, 1938, were definitely preventable.

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FOOD POISONING

U. S. S. Perkins

An outbreak of 50 cases of food poisoning occurred among the crew between 2 p. m. and 6 p. m. on April 18, 1938.

SYMPTOMS.—Nausea, vomiting, and diarrhea of moderately severe degree. Five men were moderately prostrated and, in addition to the above symptoms, complained of cramp-like pains in the muscles of the legs, shoulders, and neck. One man was slightly disorientated and complained of chills.

Mild debility characterized by soreness of the abdominal muscles and generalized weakness persisted in those cases which had been suffering most severely.

TREATMENT.—Consisted of emetics, saline purges, and ice packs to the abdomen of those men complaining of severe intestinal cramps and purgative doses of magnesium sulphate, rest, and stimulants to those prostrated. All but 12 of the men were fit for duty the next morning, April 19.

SUSPECTED FOOD.—The rations served at breakfast and dinner on April 18 consisted of:

Breakfast	*Dinner*
Fresh milk.	Breaded veal cutlets.
Wheat flakes and Ralston cereal.	Tomato gravy.
Scrambled eggs with diced bacon.	Candied parsnips.
Fried potatoes.	Bread and butter.
Cinnamon rolls.	Creamed carrots and peas.
Butter.	Boiled potatoes.
Coffee.	Coconut cream pie.
	Lemonade.

The medical officer, destroyer division 4, was of the opinion that the source of the infection was the coconut cream pie served at the noon meal. These pies had been received aboard ship from a bakery in Honolulu, Hawaii, on the morning of April 17, and placed in protected, aerated, but not refrigerated, stowage. Pies from the same lot had been served on Sunday, April 17, at the wardroom mess without any of the members developing signs of gastro-intestinal upsets.

As none of the pies remained at the time of the outbreak and as no facilities were available on board destroyers for bacteriological study of the excrements of the patients, no pertinent epidemiological data are available.

U. S. S. West Virginia

An outbreak of 31 cases of food poisoning occurred between 3 p. m. and 8 p. m. on May 13, 1938.

ONSET.—Sudden.

SYMPTOMS.—Nausea, vomiting, and diarrhea. The vomiting lasted only a few minutes in most cases, and the diarrhea was noted in all

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cases and was of short duration, 2 to 4 hours, with mild abdominal pain and intestinal colic. No abdominal distention was present. Excessive salivary secretion in a few cases and fever of a moderate degree were present, average temperature being 98.8°. Only two cases had temperature of 101°. The symptoms in all cases were not marked and no case was admitted to the sick list.

SUSPECTED FOOD.—Milk served for breakfast on the morning of May 13, 1938, was the suspected food. The milk was purchased by the supply officer on contract and delivered from the creamery in 10-gallon cans on May 12. It was stowed in the ship's cold storage at 30° F. until served for breakfast on May 13. About 1 hour before serving the milk was mixed in two batches—the first mix, about 80 gallons; the second, about 30 gallons. A specimen of the second batch was obtained for bacteriological examination and it is believed that contamination of this mix with one can of milk infected with organisms of the food poisoning group may have been the etiological factor.

Rifle Range, Camp Wesley Harris

Bread pudding caused an outbreak of food poisoning on May 20, 1938. Within 2 hours after the first admission, 15 men were transported from the camp, admitted to the sick list, and transferred to the naval hospital, Bremerton, Wash. In addition, there were 20 others between 7:30 p. m., May 20, and 2 a. m., May 21 who were not sufficiently ill to warrant their transfer from the camp. When first seen all were given warm water containing sodium bicarbonate. No further medication was administered prior to their hospitalization. All of the men referred to above were not attached to the Puget Sound Navy Yard. Of the 15 admitted and transferred to hospital, 4 were from the U. S. S. *Arizona*; 1 officer and 3 men were from the U. S. S. *Idaho*; 4 from the marine barracks; and 1 each from the receiving station, naval torpedo station, and naval ammunition depot.

SYMPTOMS.—Nausea, vomiting, diarrhea. Partial shock as evidenced by the rapid and thready pulse combined with pallor and clamminess of the skin.

SUSPECTED FOOD.—The menu of the evening meal in question consisted of curried beef; spaghetti with ground meat; sauerkraut; boiled potatoes; bread and buttter; bread pudding; and coffee. Approximately 90 men were fed at this meal and the only article of the menu eaten by all the men who were ill was the bread pudding. Inquiry and investigation of this article of the menu revealed that it had been prepared about 2 hours before the evening meal. It contained bread which had been cut some time before, milk, eggs, vanilla, and some canned fruit which had been opened for the noon meal and not entirely used. Despite the fact that the cook who prepared the meal states that the canned fruit was kept on ice and in an aluminum

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container, it is believed that contamination of the fruit may have been responsible. Since 17 men were transferred from the rifle range to the U. S. S. *Idaho* during the early afternoon of May 20, all of whom had partaken of the noon meal and of the canned fruit at noon time, and since none of them evidenced any symptoms, it is deduced that contamination of the suspected fruit followed its opening.

U. S. S. Houston

Ten days after using fresh water from the water supply at Ford Island, Pearl Harbor, Hawaii, there was a sudden outbreak of nausea, vomiting, abdominal cramps, and diarrhea, affecting approximately 35 percent of the men who subsist on the general mess; 6 percent of the chief petty officers' mess; 3 percent of the warrant officers' mess; and 10 percent of the wardroom mess. The first cases reported in the morning of April 18, 1938, and new cases developed during the following 4 days. The last case developed just before all the island water had been replaced by the ship's evaporated water. The outbreak occurred during and following the hottest days of the period in Pearl Harbor, when the individual water consumption was at its highest. All cases responded to treatment promptly and manifested no toxic symptoms. The 10 cases admitted to the sick list were returned to duty after 48 hours.

A thorough investigation was made as to a possible food poisoning on board ship, but there was no evidence of faulty preparation and the storage of food was satisfactory. All foods issued between April 16 to April 18 were prepared the day served and just prior to each meal. Upon questioning of those affected, it was found that no one case had eaten everything served on board for the 3 days. Some had eaten certain meals ashore; others had not left the ship.

None of the foods or drinks served in the ship's service store were consumed to any great extent by the men affected. All foods were stocked prior to leaving the United States.

Before the Ford Island water was received aboard an investigation was made as to its safety for human consumption. The United States Army's post surgeon reported that 3 days prior to the arrival of the fleet the water had been examined and found to be entirely satisfactory for drinking purposes.

On April 18 samples of the fresh water, taken from various spigots throughout the ship, were sent to the naval hospital, Pearl Harbor, for bacteriological examination. No organisms of the colon typhoid group were found. The highest bacterial count (280 per cc) was in the specimen containing water from the spigot in the main galley.

A report from the Ford Island Army post stated that new men arriving for duty experienced a similar condition which usually lasted a day or two.

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It is the opinion of the medical officer of the U. S. S. *Houston* that this unusual occurrence was due to the organic or inorganic substances in the water received from Ford Island and that the recent heavy rains may have caused these substances to be in greater concentration than on previous visits of the fleet.

U. S. S. Pensacola

This vessel docked in the navy yard, Pearl Harbor, Territory of Hawaii, on April 9, 1938. A patient reported to the sick bay on April 12 complaining of slight nausea, diarrhea, and abdominal cramps. A gradual increase in the number of cases occurred between this date and April 18 when the ship left the navy yard, proceeded to Ford Island, and moored alongside the U. S. S. *Houston*. The percentage of personnel affected was general mess 28 percent, officers' mess 35 percent, warrant officers' mess 30 percent, and chief petty officers' mess 25 percent. On April 19, ship's water was used and the cases gradually decreased.

Only five cases of gastro-enteritis were admitted to the sick list, and all responded well to treatment within 24 to 72 hours. No toxic symptoms were manifested.

Fresh provisions were inspected as received on board. The medical officer inspected daily the preparation of foods for the various messes and found the food to be of good quality and satisfactorily prepared.

It was the opinion of the medical officer that this outbreak was caused by the fresh water received at Pearl Harbor.

VENEREAL DISEASE

INCIDENCE ON U. S. S. "RALEIGH"

By Commander J. L. SHIPLEY, Medical Corps, United States Navy

This report is based on venereal records of the U. S. S. *Raleigh* for the interval from January 1, 1935, to May 3, 1938, inclusive, the details of which are compiled in table I.

The figures are totaled and averaged at certain times in the table, indicating a definite change in circumstances. This is usually in location of the ship, or type of duty performed, but at times it is due to a sudden and sustained variation in the incidence of venereal infections. Immediately after each total is placed a CORRECTED TOTAL, obtained in the following manner:

Infections developing in one period due to exposures in a previous period were determined from the records and, in the corrected figures, are included in that period in which exposure occurred. For this reason 3 cases occurring in January

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1936 are eliminated; 1 case is transferred from September 1935 to August 1935; 4 cases are transferred from October 1936 to the September 1936 period in Norfolk; 1 case is transferred from May to April 1937; 1 case is added to the figures for April 1938 which developed in May, after departure from the Mediterranean station.

It cannot be expected that all exposures are recorded. However, a close approximation of the number of unrecorded exposures can be arrived at by a consideration of the number of cases of infection which develop in which there is no record of exposure and prophylaxis on board ship or at an official station ashore. Such cases developed as follows:

Two cases from January to August 1935; one each in September 1935, February, March, and September 1936; two in August 1937; one each in September, October, and November 1937; two in December 1937; two in January 1938; and one each in February and April 1938. The unrecorded exposures were estimated as follows: The ratio of infections (as corrected and less cases not on prophylactic record) to exposures on record, was determined for each period and the total number of exposures for the period was increased by the number proportionate to the number of infections not on the prophylactic record. For example, total of infections January to August 1935 is 28. Three cases occurring in January were due to exposure in December and are eliminated; one case occurring in September followed exposure in August and is added; two cases occurred without record of prophylaxis having been taken. We thus have 28, minus 3, plus 1, minus 2, equals 24, which is the total number of infections associated with the total recorded exposures, i. e. 969. The ratio of infections to exposures is 24:969 or 1:40. Since two infections occurred without a record of prophylaxis, and we are adding a proportionate number of exposures to the total on record, the total to be added is 80. The final figures are, exposures 1,049, infections 26, ratio 1:40.

The time during June 1936 spent in Charleston, S. C., is considered separately, and the actual time spent in port in the Norfolk area is considered as the basis of calculation for that period. In this way the true picture at each port is obtained, each port being charged only with the infections for which it was responsible, and for the period of time passed there.

The figures in the table are not corrected for those cases taken up with a diagnosis of chancroid and later changed to syphilis. Corrected figures would show fewer cases of chancroid and more of syphilis. No correction is attempted for changes in personnel due to transfers. While on foreign station such transfers were reduced to a minimum.

In tables II and III are grouped various totals for comparison. The fleet medical officer's summary of monthly reports of new cases (original admissions) of venereal diseases, United States Fleet, for January, February, and March, 1936 is given for comparison with the *Raleigh's* figures.

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TABLE I.—*Tabulated venereal data*

Liberty ports	Date	Exposures	Venereal infections				Ratio, infections to exposures	Average strength	Annual rate per 1,000
			Gonorrhea	Chancroid	Syphilis	Total			
Mare Island	Jan. 1935	71	1	0	3	4	1:18	390	120.8
Do	Feb. 1935	87	3	0	0	3	1:29	392	99.8
Mare Island and San Diego.	Mar. 1935	113	3	1	1	5	1:23	398	147.9
San Diego	April 1935	162	2	0	2	4	1:40	447	108.9
Alaska-Honolulu	May 1035	77	1	0	0	1	1:77	566	20.8
Portland-Port Angeles-Bremerton.	July 1935	191	5	0	0	5	1:38	490	120.1
Honolulu and San Diego.	June 1935	134	2	0	1	3	1:45	499	73.1
Bremerton-Seattle-San Diego.	Aug. 1935	134	3	0	0	3	1:45	501	70.5
Total		969	20	1	7	28	1:35	460	91.4
Corrected total		1,049	21	1	4	26	1:40	460	84.9
San Diego	Sept. 1935	110	1	1	0	2	1:55	446	54.5
Do	Oct. 1935	104	1	0	0	1	1:104	441	26.7
Do	Nov. 1935	77	2	0	0	2	1:38	454	53.5
Do	Dec. 1935	72	1	0	0	1	1:72	463	25.4
Do	Jan. 1936	51	2	0	0	2	1:25	459	51.3
Total		414	7	1	0	8	1:52	452	42.2
Corrected total		483	6	1	0	7	1:69	452	36.9
San Diego	Feb. 1936	126	5	0	0	5	1:25	458	137.4
San Diego-San Francisco (4 days).	Mar. 1936	151	4	1	0	5	1:30	467	126.0
San Diego	Apr. 1936	155	4	0	1	5	1:31	550	110.6
Total		432	13	1	1	15	1:29	491	123.9
Corrected total		498				15	1:33	491	123.9
Panama Canal Zone	May 1936	251	1	0	0	1	1:251	541	21.8
Charleston-Norfolk	June 1936	229	2	1	0	3	1:76	471	77.5
Norfolk	July 1936	174	7	4	0	11	1:16	436	297.0
Do	Aug. 1936	199	1	3	2	6	1:33	489	144.5
Leave Norfolk Sept. 19, arrive Gibraltar Sept. 27.	Sept. 1936	213	4	4	0	8	1:26	527	184.7
Total		815	14	12	2	28	1:28	480	174.5
Charleston (6 days), corrected total.	June 6–12, 1936.	80	1	0	0	1	1:80	471	129.2
Norfolk (98 days), corrected total.	June 13–Sept. 19, 1936.	758	14	14	3	31	1:24	480	240.5
Gibraltar and Villefranche.	Oct. 1936	315	2	2	2	6	1:52	543	130.1
Villefranche	Nov. 1936	484	5	0	1	6	1:81	541	135.0
Villefranche and Gibraltar (8).	Dec. 1936	485	3	1	4	8	1:61	540	174.4
Villefranche (28)	Jan. 1937	517	6	2	0	8	1:65	540	174.4
Vellefranche (13), Marseilles (3), Naples (9).	Feb. 1937	633	9	0	3	12	1:53	536	291.8
Villefranche (28)	Mar. 1937	467	5	2	2	9	1:52	531	199.6
Villefranche (24), Marseilles (3).	Apr. 1937	488	8	1	2	11	1:44	530	252.5
Total		3,389	38	8	14	60	1:56	537	192.4
Corrected total		3,389	37	7	13	57	1:59	537	180.2
Villefranche (25), Marseilles (2).	May 1937	492	2	1	0	3	1:164	525	67.3
Villefranche (30)	June 1937	452	6	0	0	6	1:75	522	139.8
Villefranche (16), Lisbon (3), Oran (2), Gibraltar (3).	July 1937	587	6	0	0	6	1:98	524	134.8
Villefranche (29)	Aug. 1937	498	4	0	1	5	1:100	518	113.6

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TABLE I.—*Tabulated venereal data*—Continued

Liberty ports	Date	Exposures	Venereal infections				Ratio, infections to exposures	Average strength	Annual rate per 1,000
			Gonorrhea	Chancroid	Syphilis	Total			
Villefranche (21), Gibraltar (3).	Sept. 1937	387	4	1	1	6	1:64	519	140.6
Total		2,416	22	2	2	26	1:93	521	119.1
Corrected total		2,716	22	1	3	26	1:104	521	119.1
Gibraltar (9), Marseilles (1), Villefranche (10).	Oct. 1937	272	4	0	2	6	1:45	516	136.9
Gibraltar (8), Marseilles (1), Villefranche (17).	Nov. 1937	329	2	0	1	3	1:110	517	70.6
Marseilles (1), Villefranche (29).	Dec. 1937	324	5	2	3	10	1:32	531	221.7
Total		925	11	2	6	19	1:49	521	144.7
Corrected total		1,171	11	2	6	19	1:62	521	144.7
Villefranche (12), Genoa (4), Marseilles (1), La Spezia (3), Leghorn (3), Naples (4).	Jan. 1938	524	10	6	0	16	1:33	532	354.1
Naples (6), Palermo (7), Tunis (5), Ajaccio (4), Villefranche (4).	Feb. 1938	474	6	2	4	12	1:40	531	294.6
Total		998	16	8	4	28	1:36	531	326.2
Corrected total		1,118	16	8	4	28	1:40	531	326.2
Ajaccio (2), Marseilles (1), Villefranche (24).	Mar. 1938	247	2	1	2	5	1:49	529	111.3
Villefranche (28)	Apr. 1938	271	5	0	0	5	1:54	527	115.4
Total		518	7	1	2	10	1:52	528	113.3
Corrected total		576	7	1	2	10	1:58	528	113.3
Corrected total	Jan.-May 1938	1,694	24	9	6	39	1:43	530	218.4

TABLE II.—*Grand totals for comparison*

Force	Date	Exposures	Venereal infections				Ratio, infections to exposures	Average strength	Annual rate per 1,000
			Gonorrhea	Chancroid	Syphilis	Total			
Raleigh, 16 months, Pacific ports, official record.	January 1935–April 1936.	1,815	40	3	8	51	1:36	464	82.5
Corrected total		2,030	40	3	5	48	1:42	464	77.7
Raleigh, 19 months, Mediterranean ports, official record.	October 1936–April 1938.	8,246	94	21	28	143	1:58	529	171.0
Corrected total		8,939	94	19	28	141	1:63	529	167.2
U. S. Fleet, 3 months, Pacific ports, official record.	January–March 1936.	23,654	808	80	149	1,037	1:23	63,125	65.9

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TABLE III.—*Exposures*

Force	Date	Exposures per month	Exposures per month per man	Number of months for 1 exposure per man	Ratio, infection to exposures	Annual rate per 1,000
Raleigh, 16 months, Pacific ports, official record.	January 1935–April 1936.	113	0.24	4.1	1:36	82.5
Corrected total		127	.27	3.7	1:42	77.7
Raleigh, 19 months, Mediterranean ports, official record.	October 1936–April 1938.	434	.82	1.2	1:58	171.0
Corrected total		470	.89	1.1	1:63	167.2
U. S. Fleet, 3 months, Pacific ports, official record.	January 1936–March 1936.	7,885	.124	8.0	1:23	65.9
Raleigh, 3 months, Pacific ports, official record.	January 1936–March 1936.	109	.24	4.2	1:27	104.4

COMMENT

The figures given will be interpreted, if any interpretation is attempted, by each reader according to his own experiences and predilections. Definite conclusions, of course, cannot be drawn from the experience of one ship over comparatively short periods of time, but, if the figures given have any claims to accuracy, it is thought that the record has several points of interest.

As to accuracy, the *Raleigh* is a small ship with the small ship's characteristic that an intimate knowledge of everything that goes on aboard and ashore among the personnel is easily obtained. This intimate knowledge together with crew inspections from time to time convinced the medical officer that concealment of venereal disease with treatment ashore was of slight importance. If this be granted, it is considered that the figures given justify certain inferences, namely:

(1) The ratio of infection to exposures is as high in Pacific coast ports as in other ports of the world. The low venereal rate of the fleet, as noted in official reports, is due to a very low exposure rate. This in turn is probably associated with the increase in the marriage rate which has taken place in the fleet in recent years. In addition to marriage, it is thought that in a home port there is a reduction in the number of promiscuous exposures which are largely responsible for venereal disease. Other factors, of course, are of great, or even of primary importance, in this regard, particularly the athletic activities, and other recreational activities easily available on the west coast.

(2) Various factors affect the exposure rate and the ratio of infection to exposure. In general, these are too obvious to need mention, but some are far from obvious. For example: The exposure rate and

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the ratio of infection to exposure for the period February to April 1936, is nearly double the figures for the period immediately preceding. The ship was in its home port during both periods and apparently the cirumstances were exactly the same. The only change in circumstances that can be determined is that there was a change in the ship's administration during January 1936. Similarly, there was a noticeable and sustained drop, not in total exposures, but in the ratio of infections to exposures in May 1937. This drop coincides (*a*) with an apparent great increase in the efficient use of mechanical prohylaxis, and (*b*) Villefranche practically became a home port and promiscuous exposures were probably considerably fewer than at first. However, all exposures were recorded until publication of the order making prophylaxis and record purely voluntary.

(3) Unless it is considered that the Mediterranean ports visited are less infectious than United States ports, prophylaxis on board the *Raleigh* while on the Mediterranean station was considerably more effective than it had been previously, and very much more effective than in the fleet as a whole. That is, a ratio of infections to exposure, official record, of 1:35 in Pacific ports, 1:24 in Norfolk, and 1:58 in Mediterranean ports, while the fleet ratio was 1:23. Prior to October 1936, standard methods of prophylaxis were taught and provided. The value of mechanical prophylaxis was emphasized and mechanical appliances were on sale at the ship's service store at a nominal price. Beginning October 1, 1936, the ship's service supplied such mechanical appliances free of charge. Prophylactic packets containing the standard prophylactic tube and a mechanical appliance were made up and issued. More intensive instruction in personal hygiene was given upon assignment of the ship to foreign duty, but it is thought that the increase in efficiency of prophylaxis upon arrival on foreign station, as indicated by the record, was due to the increased use of mechanical prophylaxis. Fifty-five of the sixty-three men infected on foreign station during the last 8 months admitted that no mechanical prophylaxis was used. During the first 6 or 7 months the mechanical prophylaxis was not so effective, usually due to the deliberate action of the woman in the case, according to reports obtained. This difficulty seemed to have been largely overcome about May 1937, as noted above. From 63 records of infection available from September 1936 to August 1937, 42 infections followed admitted failure to use mechanical prophylaxis.

(4) It is interesting to note that of the 17 cases of infection occurring without record of prophylaxis 5 occurred during the 16-month period that the ship remained on the Pacific coast and 11 occurred in the 8-month period following the receipt on board of Bureau of Navigation Circular Letter 21–37, making prophylaxis entirely voluntary instead

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of mandatory. No such case occurred during the first 11 months on foreign station. A feeling of safety in a home port with consequent laxness in taking and recording the official prophylaxis is considered to be the rule. Also a laxness in this regard was to be expected upon making prophylaxis voluntary instead of mandatory.

GONORRHEA IN PEARL HARBOR AREA

NAVAL HOSPITAL REPORTS REMARKABLE RECORD

By Commander Robert P. Parsons, Medical Corps, United States Navy

Until the present year, the reporter of this news item, during some 21 years of service, largely at naval hospitals, has neither seen nor heard of a naval hospital where there were no cases of gonorrhea.

During the latter months of 1937 it was noted at the naval hospital, Pearl Harbor, that the admissions for gonorrhea were dropping to a remarkably low figure.

By the middle of 1938 we were down to a bare two or three cases of gonorrhea at a time, in an otherwise fairly busy urological and skin department. It was also noted at this time that although we had been seeing numerous cases of old syphilis, the only cases of new syphilis encountered were those in which the infection had been acquired in California. In fact, at this writing only one case of new syphilis acquired in the Territory of Hawaii has been admitted to the hospital during the past 14 months.

By July 1938, when there was not a single case of syphilis in the hospital, there were remaining in the urological ward only two cases of gonorrhea. When the last of these returned to duty August 5, 1938, there was not then a case of gonorrhea (or syphilis) in the hospital for a period of 18 days, the next gonorrhea admission occurring on August 23.

These data may be of a little importance in itself, and full interpretation is still quite an enigma to this writer, but various lines of inquiry have been undertaken in an attempt to arrive at some idea of its significance.

Reference to the Annual Report of the Surgeon General for the calendar year 1936 shows the admission rate for venereal diseases in the Fourteenth Naval District (Territory of Hawaii) to be 30.7. This is less than half the general Navy rate of 65.5 for that year. During 1936 there was an average strength of 2,831 Navy and Marine Corps personnel on duty in the district .

Statistics obtained from the Bureau of Medicine and Surgery indicate that the general Navy admission rate for venereal disease and the rate for the Fourteenth Naval District for the calendar year 1937 are lower than they were in 1936—63.9 per 1,000 and 26.4 per 1,000 respectively.

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The average strength for 1937 was 5,105. Actually, there are nearly a thousand more men in the district than is indicated by this figure, but this extra thousand is made up of the crews of ships only temporarily here for overhaul and other visits of a temporary nature. Their numbers and their admission rates are indeterminate, and can only be approximated by hospital admissions. Among the 5,105 men regularly stationed here in 1937 there were 143 admissions for gonorrhea (annual rate per 1,000, 28.0) and 21 admissions for syphilis (annual rate per 1,000, 4.1); total venereal rate, 32.1. No figures for chancroid are given because the number reported as such is so negligible and the diagnosis of true chancroid is so open to doubt since the condition is now generally regarded as being practically nonexistent.

As to the interpretation of this unique situation in Hawaii it would be foolish to hazard any definite conclusions about factors which are so impossible of measurement. Certain factors do undoubtedly have their influence but which ones and how much we cannot say. To mention a few, we may observe that in Hawaii:

1. The general morale is excellent.
2. The vigilance of civilian public health and police authorities concerning local prostitution is unusually thorough. While there is no licensed regulation there is complete cognizance of the houses and much unofficial supervision.
3. Condom prophylaxis is preached strongly.
4. Sulfanilamide. Value in reduction of sick days, reduction of period of infectivity, and reduction of complications, still undetermined.
5. Widespread effects of United States Public Health Service antisyphilis activities.

The following table was made up from data in the annual sanitary reports of the various naval activities in the Territory of Hawaii for 1937. The figures for the ships in the mine force include only the first 9 months of the year, since the ships were on the coast (principally Puget Sound area and San Francisco) during the last quarter, when, incidentally, their rates were about four times as high as they are when at Pearl Harbor.

Activity	Average strength	Gonorrhea		Syphilis		Total venereal rate [1]
		Cases	Rate [1]	Cases	Rate [1]	
Navy yard	798	13	16.3	1	1.2	17.5
Fleet-air base	1,127	26	23.1	1	0.9	24.0
Submarine base	2,190	54	24.7	13	5.9	30.6
Mine force (9 months)	888	[3] 34	[3] 51.8	[4] 4	[3] 6.8	[3] 58.6
Ammunition depot	102	4	39.2	0	0	39.2
Total	5,105	143	28.0	21	4.1	32.1

[1] Annual rate per 1,000.
[3] On annual basis this figure is 46.
[3] Computed on the annual basis.
[4] On Annual basis this figure is 6.

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STATISTICS

HEALTH OF THE NAVY

The routine coding work of the Statistical Section of the Division of Preventive Medicine has been delayed by the installation of new machinery. For this reason it has not been possible to prepare for publication in this issue the usual statistical summary of the health of the Navy.

Monthly reports of communicable diseases received in the Bureau recorded the following incidence of disease:

Common infectious diseases of the respiratory type.—A total of 2,641 admissions for these diseases were reported from the entire Navy during the second quarter of the year 1938, or a 39.3 percent decrease from the number of cases notified for the preceding quarter. Catarrhal fever was responsible for 1,769 of the total admissions for these diseases.

Ships and shore stations reporting the largest number of cases were as follows:

	April	May	June	Total
Naval training station, Newport, R. I.	89	58	39	186
Naval training station, Norfolk, Va.	57	64	62	183
Naval training station, San Diego, Calif.	42	67	64	173
U. S. S. *Lexington*	125	9	12	146
U. S. S. *Canopus*	3	68	11	82
U. S. Naval Academy, Annapolis, Md. (midshipmen)	46	30	3	79
Naval training station, Great Lakes, Ill.	21	35	12	68
Fourth regiment, marines, Shanghai, China	24	16	22	62
Marine barracks, Quantico, Va.	18	18	23	59
U. S. S. *Henderson*	5	34	20	59
Naval air station, Pensacola, Fla.	29	13	9	51

Of the 2,641 admissions for the entire Navy 1,261 admissions were reported by forces ashore and 1,380 for forces afloat.

Tonsillitis, acute, was recorded as the primary cause of one death during the quarter, the contributory cause being abscess, lung.

The sanitary report for the month of April from the naval training station, Norfolk, Va., stated that "admissions for mumps have shown a decided increase which was expected as Norfolk and the surrounding area report a large number of cases."

The U. S. S. *Enterprise* reported 16 cases of mumps for the quarter; the U. S. S. *Chaumont*, 7; naval training station, Great Lakes, Ill., 9; naval training station, San Diego, Calif., 18; and fourth regiment, Shanghai, China, 19.

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Ten cases of scarlet fever were reported for the quarter as follows: In April, 3 from the naval training station, Great Lakes, Ill., and 1 each from the receiving ship, San Diego, Calif., and the fourth regiment, Shanghai, China; and in May, 2 each from the naval training station, Great Lakes, Ill., and the U. S. S. *Colorado*, and 1 from the fourth regiment, Shanghai, China.

Cases of chickenpox were reported as follows: U. S. S. *Cincinnati*, April; U. S. S. *Lamberton*, April; naval air station, Anacostia, D. C., April; U. S. S. *Sirius*, May; and the U. S. S. *New Mexico*, June.

On May 8, 1938, a case of typhus fever was admitted to the regimental hospital, Shanghai, China, from the U. S. S. *Tulsa*. The regimental surgeon reported "the disease was undoubtedly contracted ashore as typhus fever was prevalent at that time. Rigid isolation of patient and disinfection of all effects was carried out with the cooperation of the health department of the Shanghai municipal council. No additional cases occurred from contact with this patient."

A case of cerebrospinal fever was admitted to the sick list on the U. S. S. *Honolulu* and transferred to the naval hospital, Brooklyn, N. Y. Examination on admission showed temperature of 104°; many purpuric blotches, some 1 cm in diameter, on the trunks, arms, thighs, and legs; Brudzinski's and Kernig's signs were negative; and there was no evidence of meningeal limitation. White count was 41,000. Blood culture was positive for meningococci. Definite signs of meningeal involvement developed 2 days later. Spinal puncture was done, and under normal pressure cloudy fluid was obtained. Cell count was 1,400, mostly polymorphonuclear cells, and direct smear and culture were positive for meningococci. For the next 24 hours there appeared to be some improvement, the patient being a little clearer mentally and was able to take fluids by mouth. The patient developed acute respiratory embarrassment on 24 June, 5 days after admission, and died at 7:05 p. m.

A private, 24 years of age, with 3 years and 8 months' service, was admitted to the sick list with cerebrospinal fever, marine barracks, Quantico, Va., on May 3 and discharged to duty on July 26.

A fireman, second class, 20 years of age, was admitted to the sick list on board the U. S. S. *Whipple* and transferred to the U. S. S. *Black Hawk* with encephalitis, acute. The patient was in a stuporous condition and remained moribund throughout illness on board the *Black Hawk*. He developed a temperature of 108° by axilla, very rapid pulse and respiration, and died at 9:48 p. m. June 22, 7 days after admission to sick list.

Encephalitis, lethargic was the primary cause of death of an apprentice seaman, 18 years of age, attached to the naval training

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station, Great Lakes, Ill., on April 3. Contributory cause of death, paralysis, respiratory center.

During the quarter one case of typhoid fever (a fireman, second class, 25 years of age, with 7 years' service) occurred at the navy yard, Washington, D. C., and one case (a private, 20 years of age, with 9 months' service) was admitted from the marine detachment, Tientsin, China.

One case of paratyphoid fever (a lieutenant, 34 years of age, with 14 years' service) was admitted on board the U. S. S. *Augusta* and one case (a private, 20 years of age, with 9 months' service) was admitted from marine detachment, Tientsin, China.

DEATHS

During the Second Quarter Ending June 30, 1938

Cause		Navy			Marine Corps		Nurse Corps	Total
Primary	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		9,790	1,977	104,901	1,329	17,094	424	135,515
DISEASE								
Abscess, liver	None			1				1
Carcinoma, pancreas	do				1			1
Cerebrospinal fever	do			1				1
Cirrhosis, liver, atrophic	Pneumonia, broncho	1						1
Dilatation, cardiac, acute	None			1				1
Embolism, coronary	do			1				1
Encephalitis, acute	do			1				1
Encephalitis, lethargic	Paralysis, respiratory center.			1				1
Hemorrhage, cerebral	None			1				1
Hodgkin's disease	do			1				1
Leukemia	do			1				1
Myocarditis, chronic	Neuritis, multiple			1				1
Nephritis, acute	None			1				1
Obstruction, intestinal, from internal causes.	do				1			1
Pneumonia, lobar	do			1		1		2
Do	Thrombosis, coronary artery, and arteriosclerosis, general.			1				1
Rupture, nontraumatic, aorta.	None			1				1
Septicemia	do			2				2
Thrombosis, coronary artery.	do	4		1				5
Do	Arterial hypertension	1						1
Do	Arteriosclerosis, coronary artery.			1				1
Do	Arteriosclerosis, general			1				1
Tonsillitis, acute	Abscess, lung			1				1
Tuberculosis, pleura	Pneumonia, broncho	1						1
Tuberculosis, pulmonary, acute pneumonic.	Hemorrhage, pulmonary	1						1
Tuberculosis, pulmonary, chronic, active.	None			2		2		4
Do	Pneumothorax			1				1
Tumor, malignant, mixed, adenocarcinoma.	Dysentery, amebic			1				1
Typhus fever	Pneumonia, broncho			1				1
Total for disease		8		25	2	3		38

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DURING THE SECOND QUARTER ENDING JUNE 30, 1938—Continued

Cause		Navy			Marine Corps		Nurse Corps	Total
Primary	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
INJURIES AND POISONINGS								
Drowning	None			6				6
Fracture, compound, skull	do	2		4		1		7
Fracture, simple, skull	do			4				4
Intracranial injury	do			4				4
Injuries, multiple, extreme	do	2		7				9
Rupture, traumatic, liver and lung	do			1				1
Strangulation, neck	do			1				1
Strangulation, trachea, aspiration vomitus	Alcoholism, acute			1				1
Wound, gunshot, abdomen	None			1		1		2
Wound, gunshot, chest	do	1				1		2
Wound, gunshot, head	do	1				1		2
Wound, incised, neck	do			1				1
Total for injuries and poisonings		6		30		4		40
Grand total		14		55	2	7		78
Annual death rate per 1,000:								
All diseases		5.72		2.10	6.02	1.64		2.30
Disease only		3.27		.95	6.02	.70		1.12
Drowning				.23				.18
Poisonings								
Other injuries		2.45		.92		.94		1.00

MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

STATISTICS FOR THE SECOND QUARTER ENDING JUNE 30, 1938

The following statistics were taken from sanitary reports submitted by naval training stations:

April, May, and June 1938	Naval training station			
	Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,108	628	658	1,050
Recruits appearing before board of medical survey	9	0	4	(1)
Recruits recommended for discharge from the service	9	0	4	(1)
Recruits discharged by reason of medical survey	10	0	(1)	(1)
Recruits held over pending further observation	0	0	(1)	(1)
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	27	73	45

[1] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or diseases causing the surveys were noted existing prior to enlistment. With certain diseases, survey following enlist-

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ment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Absence acquired, teeth	3	Hypertrophy, bone	1
Adhesions, abdominal, postoperative	1	Malformation, congenital	1
Arthritis, chronic	4	Malocclusion, teeth	9
Asthma	3	Metatarsalgia	1
Astigmatism	1	Myopia	1
Cardiac arrhythmia, extra systole	1	Nephroptosis	1
Caries, teeth	1	Osteoma, distal end, left femur	1
Constitutional psychopathic inferiority, without psychosis	4	Otitis, media, chronic	4
Constitutional psychopathic state, emotional instability	7	Phlebitis	1
Constitutional psychopathic state, inadequate personality	3	Polypus, nasal	1
Deafness, unilateral	1	Psoriasis	1
Defective physical development	2	Psychoneurosis, anxiety neurosis	1
Dementia praecox	1	Psychoneurosis, hysteria	1
Dermatitis (eczematous type)	1	Psychoneurosis, psychasthenia	1
Effort syndrome	3	Psychoneurosis, unclassified	1
Enuresis	12	Pyorrhea alveolaris	1
Epilepsy	7	Rheumatic fever	1
Flat foot	26	Somnambulism	4
Hammer-toe	1	Syphilis	5
Hay fever	1	Tonsillitis, chronic	1
		Union of fracture, faulty	3
		Urticaria	1
		Valvular heart disease, mitral stenosis	2

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UNITED STATES NAVAL MEDICAL BULLETIN

FOR THE INFORMATION OF
THE MEDICAL DEPARTMENT OF THE NAVY

DIVISION OF PUBLICATIONS
THE BUREAU OF MEDICINE AND SURGERY

THE MISSION OF THE MEDICAL DEPARTMENT OF THE NAVY

TO KEEP AS MANY MEN AT AS MANY GUNS AS MANY DAYS AS POSSIBLE

Compiled and published under the authority of Naval Appropriation Act for 1938-39, approved April 26, 1938

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary,

Owing to exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

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Volume XXVII, 1929, Nos. 3 and 4.
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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of professional interest.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T. MCINTIRE,
Surgeon General, United States Navy.

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NOTICE TO CONTRIBUTORS

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The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

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The BULLETIN intends to print only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.

EBEN E. SMITH, *Editor*,
Commander, Medical Corps, United States Navy.

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U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVII APRIL 1939 No. 2

SPECIAL ARTICLES

REVIEW OF THE TREATMENT OF SYPHILIS

By Asst. Surg. Gen. R. A. Vonderlehr, United States Public Health Service

The modern treatment of syphilis is based upon studies conducted during the past 10 years by the Medical Organization of the League of Nations, and by a number of prominent syphilologists in this country, known collectively as the cooperative clinical group, whose work has been coordinated and assisted by the United States Public Health Service.

Indications for the several schemes of antisyphilitic therapy will be considered briefly here on a chronological basis with reference to the duration of the disease. The limitation of space requires that the conventional classifications of syphilis be not followed in this review.

It is the present concensus of scientific opinion that the therapeutic principles for syphilis, except when the late crippling manifestations exist, have so wide a degree of applicability that they may be formulated into definite rules and systems for all but universal use. The standard schemes here recommended may be applied in all patients so long as intolerance in the form of untoward reactions is not exhibited. If tolerance fails the case becomes one for consultation.

Table 1 presents the scheme for the treatment of syphilis of less than 5 years' duration. The characteristics of this plan are continuity and alternation. Arsphenamine (606) is the arsenical compound of choice. Bismuth is the preferred heavy metal, the insoluble subsalicylate when funds are limited, and oil-soluble compounds when the budgetary allowance is more generous.

With syphilis of 5 or more years' duration, and the complete absence of all subjective and objective evidence of disease except the positive serologic blood test, the scheme outlined in table 2 is indicated. It should be remembered that symptomless syphilis tends naturally toward spontaneous "cure" although this tendency is markedly enhanced by proper treatment. The plan in table 2, therefore, calls for less vigorous treatment. Rest periods are allowed. Neoarsphenamine (914) is preferred to arsphenamine (606) although the same bismuth preparations are recommended. Greater emphasis is placed upon the duration of bismuth therapy.

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TABLE 1

A scheme of treatment for syphilis of less than 5 years' duration [1]

Day or week	Arsphenamine	Interim treatment	Blood Wassermann reaction	Remarks
Day				
1	0.3–0.6		1	Arsphenamine dosage for first 3 injections at level of 0.1 gram for each 25 pounds of body weight. Average subsequent dosage, 0.4 gram, men; 0.3 gram, women. In average patient all lesions heal rapidly and blood serologic test becomes negative during first course. If arsphenamine cannot be used, substitute 8 to 10 doses 0.3 gram silver arsphenamine, or 10 to 12 doses 0.6 gram neoarsphenamine. This applies also to subsequent courses.
5	0.3–0.6			
10	0.3–0.6			
Week				
3	.4			
4	.4			
5	.4			
6	.4			
7	.4			
8	----------	Bismuth, 4 doses 0.2 gram and K. I. or Ung. Hg. and K. I.	----------	
9	----------			
10	----------		1	If mercury is used, note overlap of 1 week at end of first and start of second arsphenamine courses.
11	----------			At this point a few days without treatment may be dangerous (neurorecurrence).
12	.4		1	Arsphenamine starts, bismuth stops. Watch for provocative Wassermann reaction after first dose of arsphenamine.
13	.4			
14	.4		----------	Try to prevent lapses in treatment, especially at this early stage.
15	.4			
16	.4			
17	.4		1	
18–23	----------	Bismuth, 6 doses or Ung. Hg. and K. I.	----------	Bismuth is better than mercury. Use it if possible. Examine cerebrospinal fluid, at about this time.
24	.4			
25	.4			
26	.4			
27	.4			
28	.4			
29	.4			
30–37	----------	Bismuth, 8 doses or Hg. and K. I.	----------	
38	.4		1	
39	.4			
40	.4			
41	.4			
42	.4			
43	.4		1	Patients with seronegative primary syphilis may cease treatment here, if blood serologic test has always been negative.
44–53	----------	Bismuth, 10 doses or Ung. Hg. and K. I.	----------	Note that bismuth or mercury courses are now gradually getting longer—4, 6, 8, and now 10 weeks.
54	.4		1	
55	.4		----------	The average seropositive primary or early secondary patient should have at least 5 courses of arsphenamine.
56	.4			
57	.4			
58	.4			
59	.4		1	

[1] Reprinted with slight modifications, from The Management of Syphilis in General Practice, by J. E. Moore, M. D., Ven. Dis. Inform., Washington, 10: 53 (87) 1929.

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TABLE 1—Continued

A scheme of treatment for syphilis of less than 5 years' duration—Continued

Day or week	Arsphenamine	Interim treatment	Blood Wassermann reaction	Remarks
Day 60–69		Bismuth, 10 doses or Ung. Hg. and K. I.		It is safer to finish treatment with bismuth or mercury rather than with arsphenamine.
70–122	Probation	No treatment.....	6–12	Blood serologic test every month if possible; at least every other month.
123	Complete physical and neurologic examination, spinal puncture, and, if possible, fluoroscopic examination of cardiovascular stripe. Thereafter, yearly physical examinations, blood serologic test every 6 to 12 months. If the 2 spinal fluid examinations above are negative, this need not be repeated later.			

The aim of treatment in pregnant syphilitic women is the prevention of the transmission of the disease to the unborn child. Regardless of the stage of syphilis in the mother, treatment should be by the same scheme as that described in table 1. This method of therapy should be started as early as possible in the gestation period and continued until the end of term. The treatment scheme after delivery is modified in accordance with the stage of syphilis in the woman.

No single scheme of treatment is known for patients with syphilis of 5 or more years' duration when the manifestations of late crippling disease exist. This statement applies even to patients with a symptomatic neurosyphilis or in whom uncomplicated aortitis is suspected.

The schemes described above are recommended because it is possible to attain the best results from the standpoint of the public health and for the patient through their application. Some of these results are the following:

1. Communicability of syphilis is immediately terminated and infectious relapse occurs in only 1.4 percent of the patients so treated.
2. When this treatment is started during the first year of the syphilitic infection, "cure" is attained in 9 out of 10 patients.
3. If the recommended treatment is begun before the fifth month of pregnancy the unborn child will be healthy in 91 percent of the cases.
4. The treatment schemes described, when used in patients with syphilis of more than 1 year's duration, materially enhance the chances of complete recovery.

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TABLE 2

A scheme of treatment for symptomless syphilis of 5 or more years' duration [1]

1. Complete and thorough physical examination.
2. Routine test of spinal fluid before starting treatment, or as soon thereafter as possible.
3. Weeks 1–7 Neoarsphenamine, 8 weekly doses, 0.45–0.6 g.
 8–17 Bismuth, 8–10 weekly doses.
 18–25 Neoarsphenamine, 8 weekly doses.
 26–37 Bismuth, 12 weekly doses.
 38–45 Neoarsphenamine, 8 weekly doses.
 46–57 Bismuth, 12 weekly doses.
 58–69 Rest period.
 70–81 Bismuth, 12 weekly doses.
 82–93 Rest period.
 94–105 Bismuth, 12 weekly doses.

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[1] Reprinted with slight modifications, from The Modern Treatment of Syphilis, by J. E. Moore, M. D., Charles C. Thomas, Springfield and Baltimore, 1933, p. 246.

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SYPHILIS IN THE NAVY

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INTRODUCTION

No study of syphilis in the Navy has ever approached in number of patients the undertaking of the cooperative clinic group. However, a study of treatment results of naval syphilitics among enlisted personnel should afford much more accurate statistics than can be obtained in civilian life. This is apparent from the fact that the majority of civilian patients are soon lost sight of after completing treatment. In fact less than half of civilian patients remain for even minimum effective treatment as shown by the recent Chicago survey in which only 23 percent of private patients and 52 percent of clinic patients received the minimum effective therapy before they disappeared from observation.[1] Of those who do remain for minimum effective treatment, a large percentage are lost track of shortly after they finish treatment. In the cooperative clinic group figures, results could only be judged between 6.5 to 75 percent as to ultimate cure.[2] Because of loss of patients from observation, only 6.5 percent of the total number treated by the cooperative clinics were examined and actually found to have had a cure effected; another 25 percent were known to have had relapses or other unsatisfactory results; somewhere between 6.5 and 75 percent lies the true figure of satisfactory courses for the total number treated.

A study of syphilis in the Navy, on the other hand, where the men and their records are always at hand, should give an almost exact estimate of the results to be expected from the type of treatment these men have received. It is true that a large number of men with syphilis do not reenlist and are thus lost for study. However, this should make no statistical error, as there is no reason to suspect any difference in the relative percentages of good treatment or poor treatment, of good results or poor results, between the men remaining in the Navy or of those getting out.

Arbuckle in his study into the individual abilities of syphilitics on board the U. S. S. *Tennessee*, arrived at the conclusion that they rated at least as high as the nonluetics on board.[3] From this there is no reason to suspect that there is a bigger percentage of syphilitics lost because of inaptitude, summary courts, etc., than of nonsyphilitics. Even if there were, it would probably make no difference in statistical findings, and this is merely mentioned here as an interesting and probably unexpected possibility.

[1] Usilton, L. J., Hunter, H., and Vonderlehr, R. A.: Prevalence, incidence, and trend of syphilis in Chicago in spring and summer of 1937, J. A. M. A. 110: 864-869, 1938.
[2] Stokes, J. H.: Modern Clinical Syphilology. Second Edition. W. B. Saunders, Philadelphia, Pa., 1934.
[3] Arbuckle, L. D.: U. S. Nav. Med. Bull., 34: 595-597, 1936.

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The only circumstance that would bring about an actual relative difference would be in men receiving medical discharges from the Navy due to some defect brought on from their syphilitic infection, and these would show up in the annual statistical report.

A study, then, of naval syphilitics should give an accurate estimate of results to be expected, up to the twentieth year of infection, from the different treatment systems as practiced in the service. Twenty years infection would be the maximum in enlisted personnel, assuming a man to receive his infection shortly after his enlistment, and going out on 20-year retirement.

MATERIAL OF STUDY

This study is based on 496 syphilitic records of the U. S. Submarine Base at New London, Conn., the U. S. S. *Richmond*, the U. S. S. *Brooklyn*, the receiving ship at New York Navy Yard, and six destroyers (the *Badger*, *Decator*, *Fairfax*, *Herbert*, *Leary*, and *J. F. Talbott*). The records and men of the submarine base, comprising a total of 220, were available at all times and were gone into more thoroughly from more angles. All men on the submarine base, except two who were transferred before this could be done, received spinal punctures and complete physical examinations. All of the men attached to the submarine base on July 1, 1938, received fluoroscopic examinations.

As expected, a certain number of the syphilitic records were incomplete. Either the original syphilitic sheet had been lost or removed, or the sheet was too inadequately filled in to be of any use. There were 25 such records in the total group. A study of the present results of these men, as judged from spinal, physical, and fluoroscopic studies of men attached to the base, and from the abstracts of the other men, would not indicate that they would materially affect these statistics.

IMPROVEMENT IN NAVY TREATMENT

Navy treatment of syphilis has shown an improvement in recent years. Chart 1, combining my figures of 1934 with those of the present paper, shows this steady improvement.[4]

The 1937 and 1938 cases have been mostly under the supervision of only five medical officers, and so are not necessarily a true cross-section of treatment throughout the Navy. However, in view of the progressively higher percentage of adequately treated cases from year to year, it can safely be said that naval treatment as a whole will closely approximate the 1937–38 figures. There is no reason why naval personnel should not receive 100 percent adequate treat-

[4] Ekblad, G. H.: U. S. Nav. Med. Bull. 32: 506–513, 1934.

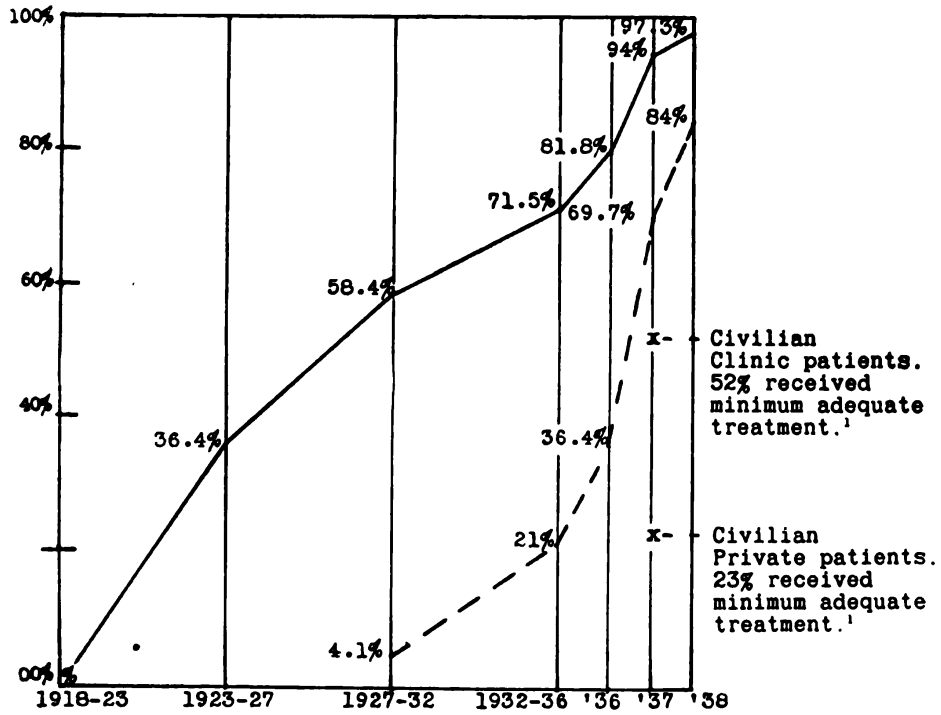
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ment. This is probably impossible for continuous treatment, due to transfer of men from station to station, but even continuous treat ment should approach 90 to 95 percent.

In comparison, civilian patients average only 12 injections of arsphenamine with interim heavy metal during the first 2 years, as shown by the extensive 1937 survey in Chicago.[1] This average has been raised during the past year to 15 injections under the influence

CHART 1

Percentage of 555 Navy syphilitics receiving early adequate treatment



——— Adequate early treatment of any type (20 or more arsenicals, plus interim heavy metal, in the first 15 months of treatment).

- - - - - Continuous treatment. (No rest periods. On arsenicals or heavy metals at all times, usually alternating. Minimum of 20 arsenicals, plus heavy metal, in the first 15 months of treatment.)

of the present publicity campaign against syphilis. Whether this level will continue to be raised, or whether it will slide back, remains to be seen. It is probably impossible for civilian treatment ever to approach that obtainable under peace-time military control; providing, of course, that medical officers are alert to the demands of syphilis.

With this improvement in naval treatment there should, beginning with patients receiving their infection about 5 years ago, be a yearly reduction among enlisted personnel in the number of relapses and of clinical progression to serious complications in later years.

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SEROLOGIC GUIDE IN THE TREATMENT OF SYPHILIS

Authorities on syphilis are practically unanimous in insisting upon at least 1 full year of treatment **after** negative serology, treatment to include at least 20 arsenicals with interim heavy metal. Most of them insist upon more than this if the treatment has not been continuous. In spite of this agreement on the importance of treatment after negative serology, I have been unable to find statistics on this subject. Table 1 shows the importance of adequate treatment after negative serology.

TABLE 1

Probability of serological relapse after becoming seronegative compared with number of arsenicals received during the subsequent year

Cases	Average number of arsenicals received during following year	Relapse		No relapse	
		Number	Percent	Number	Percent
145	20	9	6.2	136	93.8
60	15	12	20.0	48	80.0
67	10	21	31.4	46	68.6
50	5	27	54.0	23	46.0
102	0	77	75.1	25	24.9
Total, 402		146	34.4	278	65.6

Only treatment given in the first year after serologic negativity was counted in compiling these results. Most of this treatment was given without any strict regard to schedule, but as a whole was fairly regular.

TABLE 2

Frequency of relapse in seronegative individuals who have received various types of early antisyphilitic treatment and various amounts of subsequent arsenical treatment

Type of early treatment	Number of cases studied	No relapse						Relapse					
		Grouped according to number of subsequent arsenical treatments					Total	Grouped according to number of subsequent arsenical treatments					Total
		0	5	10	15	20+		0	5	10	15	20+	
Continuous	22	----	----	1	----	19	20	----	1	----	----	1	2
Adequate intermittent	86	3	4	12	17	33	69	10	2	1	2	2	17
Inadequate	82	8	9	9	10	3	39	26	7	8	2	----	43
Total	190	11	13	22	27	55	128	36	10	9	4	3	62

In table 2, 190 cases from the submarine base show results to be expected from a combination of our different types of treatment plus post-negative treatment. The number of cases is too small to break

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up into the number of boxes shown in table 2 and still expect an accurate estimate of results, but it does give us a general estimate of results that might be expected.

Table 2 shows a surprising finding, in that even cases receiving inadequate treatment early (first 15 months), if they receive fair to good treatment after negative serology, will approach results of the continuous system.

PREVENTION OF RELAPSE

Continuous Versus Intermittent Treatment

Nothing is offered here but additional confirmation of the cooperative group clinic findings that continuous treatment shows a distinct superiority over intermittent treatment in preventing relapse.

Table 3

Percentage of satisfactory serological treatment results on naval patients

Treatment	Authors 447 cases 1–20 years infection				Combined results Ekblad [4] and McDonald [5] and present series
	Stage of infection				
	Sero-Negative primary	Sero-Positive primary	Secondary	All stages	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*
Continuous	100	94.7	88.4	93.7	91.0
Adequate intermittent	89.3	64.8	70.0	72.2	----------
Inadequate	52.0	42.6	39.0	43.7	----------
Intermittent adequate or inadequate	----------	----------	----------	----------	63.4

The criteria of continuous and intermittent treatment of the American and League of Nations Investigations [6] were not strictly adhered to. Their criteria for continuous treatment are 63–65 weeks of treatment with no breaks, and a minimum of 32 doses of arsphenamine with appropriate heavy metal. Their criteria for intermittent treatment are a similar amount of treatment given in a period of 21 months. Less strict requirements have been used in this paper. Grouped in the continuous treatment are all cases receiving continuous treatment for the first year, with not more than 1 week's lapse in treatment during the first 6 months, or more than 1 month's lapse in treatment during the second 6 months, and a minimum of 20 arsenicals plus appropriate heavy metal. In the intermittent treatment group are all cases not receiving continuous treatment but receiving a minimum of 20 arsenicals plus appropriate heavy metal during the first 12–15 months of treatment.

[5] McDonald, L. E.: U. S. Nav. Med. Bull., 32: 497–506, 1934.

[6] Continuous and Intermittent Treatment for Early Syphilis. U. S. Pub. Health, reprint No. 63 from Venereal Disease Information, 1937.

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Patients with continuous treatment in table 3 average only 3.1 years of infection, as compared to 7.2 years in the adequate intermittent group and 8.63 years in the inadequately treated group, so that there may be more relapses in the continuous group with further observation, but the results to date are very encouraging.

The results of the inadequately treated group are probably not as good as indicated in table 3. A number of these men, on questioning, claimed to have had from 8 to 50 more injections than shown in their luetic abstracts. The majority of these men are in the group having satisfactory results. If their assertions are true, the percentage of satisfactory cases under inadequate treatment would be less than shown as these men would actually belong in the intermittent treatment group.

The men who claimed to have had more treatment than recorded were on small boats at the time and received their injections on tenders, at hospitals, or dispensaries. Unquestionably many of these injections were never recorded by the personnel having custody of their health records.

Standard of Treatment

Tables 1 and 2 show the importance of treatment after negative serology. Tables 3 and 4 show the superiority of continuous treatment as compared to other types of treatment. A combination of these two spearheads in antisyphilitic treatment should give us our best possible results.

I think we can safely state the following criteria for good antisyphilitic treatment: Continuous treatment, to be carried on until 25–30 arsenicals, plus appropriate heavy metal, have been given after negative serology.

SEROLOGY AS A GUIDE IN PROGNOSIS

Table 3 shows that the earlier the diagnosis is made and treatment started, the better the prognosis. The one exception is the adequately intermittent treatment group, where seropositive primary cases do not give as good results as the secondary group, 64.8 percent serologically satisfactory courses as compared with 70 percent. However, where seropositive primary cases are in the continuous treatment group, they conform to our first statement.

Table 4 shows that a patient's probable prognosis can be judged by the reversibility of his blood test and that the quicker a patient's blood reverts to negative, the better the prognosis we can promise him. This table summarizes 447 cases with 1 to 20 years of infection and with all types of treatment.

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TABLE 4

Time interval from original infection of individual to becoming serologically negative determines the probability of serologiacl relapse

Blood Kahn negative in—	Percentage of cases which have had serologic relapse, or are Kahn fast at present
	Percent
Seronegative primary	23.0
Less than 3 months	29.0
3–5 months	30.6
6–11 months	52.8
12 months and over	68.0

SEROLOGICAL EFFECT OF TREATMENT METHODS IN EARLY SYPHILIS

From table 4, the treatment system affording the quickest blood Kahn reversal would naturally be expected to give the best results. Here again continuous treatment shows a distinct superiority over the intermittent type of treatment, as shown in table 5.

TABLE 5

Percentage of patients in whom Kahn or Wassermann was reversed under stated treatment schemes

Kahn or Wassermann reversed in—	Seronegative primary cases not included in Navy figures, and presumably not in the cooperative clinic group figures					
	Navy, 339 cases			Data, cooperative clinic group [1]		
	Continuous	Intermittent	Inadequate	Continuous	Intermittent	Irregular
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Less than 3 months	63.0	34.3	32.4	52.6	3.8	
3–5 months	91.0	61.0	59.7			
Less than 12 months	98.0	83.8	81.4	81.8	37.3	4.7
Total reversals	98.0	98.2	99.2	86.7	57.1	47.7

The intermittent treatment figures probably suffer to the benefit of the inadequately treated group, in that many men receiving very poor treatment during the first 6 months or so of their infection, would, when their blood failed to reverse, suddenly be given enough treatment to place them in the adequately treated group by the end of the first 15 months.

One interesting observation here is that most any type of treatment, if persisted in, will eventually wear down the blood Kahn; and as indicated in table 2, if post-negative serology treatment were kept up, would probably yield excellent results.

[1] Moore, J. E.: The Modern Treatment of Syphilis. Charles C. Thomas, Baltimore, Md., 1933.

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The longest any patient in this series remained Kahn fast before reversal was 6 years. The patients Kahn fast at the present time (basing Kahn fast as 1 year or more of positive blood—either originally Kahn fast, or relapsed) are of 1 to 3½ years duration, plus two cases of 5 years duration. Some of those in whom the blood reversed normally to negative, only to relapse later, are now in the Kahn fast category, having run positive bloods up to as long as 2½ years at the present time. This latter group are included in table 5 as normally reversed cases. In other words table 5 gives the percentages of total cases reversing from a positive to a negative blood at some time in their course, but does not mean these reversals are necessarily permanent reversals—e. g., no relapses.

RELAPSE—TIME OF OCCURRENCE

Relapses are tabulated in table 6 in the year they occurred after treatment was discontinued; and in table 7 in the year of infection in which they occurred.

TABLE 6

Time of occurrence of relapse after discontinuance of treatment, author's group

Time of occurrence of relapse in years	Number of relapses	Percent occurrence during year	Accumulative percent occurrence
Less than 1	101	54.9	54.9
1	40	21.7	76.6
2	19	10.3	87.0
3	13	7.1	94.0
4 and over	11	6.0	100.0
Total	184	100.0	100.0

TABLE 7

Time of occurrence of relapse in relation to year of primary infection, submarine base and McDonald group

Duration of infection in years	Number of relapses	Percent of total relapses	Accumulative percent relapses
Less than 1	47	32.0	32.0
1	40	27.2	59.2
2	23	15.7	74.8
3	13	8.8	83.7
4 and over	24	16.3	100.0
Total	147	100.0	100.0

From this we see that over half of our serologic relapses will occur during the first year after discontinuation of treatment, or during the second year of infection. And that three-quarters of them will occur during the second year after discontinuation of treatment, or during the third year of infection. By the fourth year after treatment, or

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the fifth year of infection, almost 95 percent of serologic relapses will have occurred that are going to occur, so that in patients of 5 years or more of infection we can promise that there will be only 1 chance in 20 of a serologic relapse.

Although not tabulated here, the stage in which syphilis was diagnosed seemed to make little difference in the time at which relapses occurred. With one exception, inadequately treated seronegative primary cases showed a strong predilection to relapse very early.

ULTIMATE RESULTS OF SEROLOGIC RELAPSED CASES

A study of the records of the submarine base shows that most of the cases showing serologic relapse can obtain good results with further treatment, as shown in table 8.

TABLE 8

200 cases, 1–20 years of infection. Percentage clinically and serologically (blood and spinal fluid) negative

Treatment	Satisfactory throughout entire course[a]	Satisfactory at present[b]
	Percent	*Percent*
Continuous	89.5	92.6
Adequate intermittent	76.0	92.6
Inadequate	45.0	75.0

[a] Includes 8 spinals in group Ia (Moore's classification).
[b] Includes 15 spinals in group Ia (Moore's classification).

The submarine base figures show the surprising fact that the intermittent treatment group cases reach a final figure on a par with that of the continuous treatment group. However, this must be interpreted with caution. The following factors must be taken into consideration: (*a*) the intermittent treatment group required more treatment; (*b*) while both the continuous and the intermittent treatment group show 93 percent satisfactory results at the present time, there are a larger percentage of relapsed cases in the intermittent treatment group, and these cases will not be as good risks as the nonrelapsed cases; (*c*) of the 7 percent not satisfactory in the two groups at the present time, this represents in the continuous group nothing worse than two cases of blood reversals and group I spinal fluid, in the intermittent treatment group this 7 percent represents Kahn fast cases of 1 to 5 years duration, and one group II spinal.

AVERAGE AMOUNT OF NAVY TREATMENT

Table 9 shows the average amount of Navy treatment given under different treatment systems, and also the average amount required to obtain the results shown.

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TABLE 9

Average number of arsenical injections under stated treatment schemes, 200 cases

Treatment	Satisfactory cases		Relapsed cases [a]		Total all cases
	First 15 months	Total	First 15 months	Total	
Continuous	26	26.2	[b] 26.1	63.3	29.8
Intermittent	26	36	28	73.2	42.5
Inadequate	[c] 13.6	[c] 20.7	12	65.4	[c] 37.7

[a] The increase in total number of injections in the relapsed cases is of course due to treatment after relapses. Kahn fast cases are included with the relapsed cases. These cases generally run 20–30 heavy metal to 20 arsenicals. Treatment given after the first 12-15 months, if there had been no relapse, was usually of a sporadic nature.

[b] Increase in treatment here over the satisfactory group is largely due to the fact that cases requiring more than the average treatment and time for Kahn reversal will fall into this group.

[c] This low figure has the same possible explanation as given previously (that all shots received were not recorded).

Comparison of tables 8 and 9 shows that continuous treatment is superior to adequate intermittent treatment in the ratio of 89.3 percent to 76 percent of cases that run a satisfactory smooth course on the same amount of early treatment (e. g., 26 arsenicals), and requires less total treatment (e. g., 29.8 to 42.5 arsenicals). Also in the cases running an entirely smooth course, less total treatment was required in the continuous as compared to the intermittent treatment group, e. g. 26.2 to 36 arsenicals.

STAGE OF EARLY SYPHILIS ON ADMISSION

Table 10 gives a comparision of the stage of infection in early syphilis at the time of diagnosis in naval and civilian practice. The civilian percentages are calculated from data on the 1937 Chicago survey.[1]

TABLE 10

Stage of early syphilis on diagnosis

Stage	Chicago survey, 2,918 cases	Navy, 471 cases
	Percent	*Percent*
Seronegative primary	9.8	24.4
Seropositive primary	28.8	33.5
Secondary	61.4	42.1

From the larger percentage of cases diagnosed seronegative primary in the Navy, it stands that the naval syphilitic begins with a distinct advantage over his civilian brethren. From table 3, however, civilian syphilitics will show a slight advantage over naval syphilitics in their smaller percentage of seropositive primary cases, unless these naval cases are under a continuous treatment system.

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SYMPTOMLESS INFECTION

Symptomless infection is probably not nearly as common an occurrence as shown by civilian figures. A check of 485 records (includes cases not included in other figures because of insufficient length of infection, insufficient data on treatment), shows that in only 2.7 percent of the infections was treatment instituted on positive blood serology alone without primary or secondary evidence of syphilis. The number of symptomless infections at large and undiagnosed in the Navy is probably not significant, because enlisted naval personnel are hospitalized for minor sicknesses, such as colds and similar small complaints, which in civilian life would be taken care of at home and often without medical attention. Most of these men then receive routine blood Kahn tests, and probably few cases escape undiagnosed. The only ones who would escape this dragnet would be those receiving civilian treatment on the quiet, and these cases would certainly not be symptomless infections.

This leads to the conclusion that symptomless infection does not occur oftener than in about 3 to 5 percent of male syphilitic infections. Moore's [7] figure on symptomless infection includes female cases which will raise the percentage considerably; nevertheless, his figure of 43 percent symptomless infection in a large series of latent syphilis must mean that our general syphilitic public is either very unobserving, very forgetful, or deliberately conceals the condition.

REINFECTION

A satisfactory definition of reinfection is not possible. Reinfection is either interpreted so rigidly that the rules of chance practically rule out reinfection, or it is interpreted so loosely that it means nothing. We can only arrive at a compromise.

Stokes [2] gives reinfection as occurring once in 228 cases in his group of primary and secondary syphilis, and quotes figures from Moore and Kemp of one in 131. Combining the figures of Prehn [8] and Millspaugh [9] with the present series, we find that reinfection has been diagnosed 47 times in 1,241 records, or 3.7 percent. This figure is obviously too high in comparison with other figures, but what are we going to use as a working basis for determining reinfection?

Quoting Moore's [7] criteria for reinfection, which are not as strict as those of Stokes:

1. There must be proof that the patient had syphilis prior to the occurrence of the suspected second infection, and this proof must rest on the demonstration of spirochetes in a lesion or the occurrence of a positive blood Wassermann reaction in the blood serum and not on clinical judgment alone.

2. After an interval following antisyphilitic treatment and at a site other than that of the primary lesion of the first infection, there must develop a lesion with the characteristics of a chancre in which spirochetes can be demonstrated.

[8] Prehn, D. T.: U. S. Nav. Med. Bull. **35**: 450–460, 1937.
[9] Millspaugh, J. A.: U. S. Nav. Med. Bull. **35**: 241–243, 1937.

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3. That at the time of the supposed second infection the blood Wassermann reaction is negative; and that while under observation and during a period in which treatment is purposely withheld, the blood Wassermann becomes positive or the patient develops outspoken secondary syphilis.

On the basis of these criteria the third, alone, would probably rule out close to 100 percent of Navy reinfections. Assuming that reinfections do actually occur, the following criteria, while grossly inadequate compared to most criteria, are proposed as affording a reasonable working basis for determining reinfection.

1. Proof of syphilis prior to the occurrence of the suspected second infection, and this proof must rest on the demonstration of spirochetes in a lesion or the occurrence of a positive blood Kahn reaction in the blood serum and not on clinical judgment alone.

2. After an interval of at least one year following adequate antisyphilitic treatment, and following exposure, there must develop a lesion with the characteristics of a chancre, and: (*a*) spirochetes be demonstrated in this lesion, or (*b*) the blood serum be positive or become positive.

Development of secondaries could not be included without the presence of 2*a*, or 2*b* as it would not satisfy criteria 1 that the diagnosis not be made on clinical judgment alone.

The above criteria will rule out reinfections when: (*a*) The first infection has had inadequate treatment; (*b*) the patient cannot or will not give history of exposure; (*c*) reinfections occurring in the first year after antisyphilitic treatment. Relapses meeting the requirements of the above criteria, and occurring after the first post-treatment year, will be erroneously included as reinfections.

Applying these criteria with their acknowledged short-comings, I find that 20 out of 735 cases (combining figures of Millspaugh and my own), or 2.7 percent, meet the requirements of reinfection. The percentages were the same in the two series, but in the records listed by Millspaugh 7 out of 18, and in mine 13 out of 18, may be regarded as reinfections.

CARDIOVASCULAR SYPHILIS

Cardiovascular syphilis is usually a sign of inadequate treatment. Eighty-two percent of cardiovascular syphilis in the Chicago survey had had absolutely no previous treatment.[1] Cooperative Clinical Group studies showed 69 percent of cardiovascular syphilis had had no previous treatment or only a little heavy metal.[10]

Detection of early uncomplicated syphilitic aortitis is not easy. Moore, Danglade, and Reisinger compared the accuracy of clinical and pathological diagnosis in 105 patients with syphilitic aortitis proved at necropsy in the Johns Hopkins Hospital.[7] The histories were taken and physical examinations performed by many members of a large staff. The diagnosis was correctly made antemortem in only 4 out of the 105 patients: It was suspected but not definitely

[10] Cooperative clinical studies in the treatment of syphilis. J. A. M. A. 108: 1861–66, 1937.

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made in 13 others. In other words, in an excellent modern hospital the diagnosis was made or considered in 16 percent of the patients, and was missed in 84 percent. A critical survey of the patients' records indicated that the diagnosis might have been reached in 52 of the patients on the basis of the actual recordings of symptoms and physical signs whose importance passed unheeded. Moore and associates,[7] and the Cooperative Clinical Group[10] use the following criteria for diagnosis of cardiovascular syphilis given in the order of their importance:

1. Teleroentgenographic and fluoroscopic evidence of aortic dilatation.
2. A tympanitic, bell-like, tambour accentuation of the second aortic sound.
3. A history of circulatory embarrassment.
4. Increased retromanubrial dullness.
5. Progressive cardiac failure.
6. Substernal pain.
7. Paroxysmal dyspnea.

Moore and associates feel that the presence of three or more of these signs and symptoms in a syphilitic patient under 50 years of age, free from mitral disease and in the absence of hypertension, are strong evidence for the diagnosis of uncomplicated syphilitic aortitis and that the presence of any two of them renders the diagnosis probable.

Examinations of 220 syphilitics on the submarine base were entirely negative for any of these criteria except three men with questionable tambour second aortic sound. However, an examination of 100 non-luetic men on the base, of the same relative age, revealed this same sound in two, both of whom had negative blood Kahns and negative physicals. In all these cases the tambour sound disappeared on re-examination in quiet surroundings and with the patient more at ease.

Fluoroscopic examinations were not done on all the men but only on those on duty at the base at the present time (July 1938), 112 men. These were all within normal limits.

These cases should be a fair cross-section of the Navy, excluding hospital patients. Navy nomenclature for diseases does not include the primary cause of illness except in case of death or survey. In the 1936 statistics[11] the following admissions occur which may be of syphilitic origin: aortic aneurysm, 2; aortitis, 2; aortic insufficiency, 1.

There also were 6 admissions for cerebral hemorrhage, some of which may have been of syphilitic origin. This is out of a syphilitic census total of 14,427 in 1936.[11]

In the 447 records in this series, of 1–19 years infection, there were the following age groups:

5–9 year group	195 men.
10–14 year group	77 men.
15–19 year group	21 men.
5–19 year group	293 men, or 65.5 percent.

[11] Statistics of Diseases and Injuries in the U. S. Navy for the Year 1936.

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If these ratios are representative for the entire service, there should be approximately 8,552 patients in the naval syphilitic census in the 5–19 year group. Assuming 8 of the above cardiac admissions to be of syphilitic origin, and assuming we have missed the diagnosis in 84 percent of cases, as in the Johns Hopkins figures, we have 50 men with cardiac complications, or 0.58 percent. Other factors, as previously diagnosed cases, will raise this figure to an amount that can only be guessed at, but probably to not more than 1 percent, to give us the true incidence of cardiovascular syphilis of men in the Navy at the present time.

This low figure is not entirely surprising. Moore [7] states that he cannot recall having seen any patient, having received as many as 24 injections of arsphenamine, developing evidence of cardiovascular damage. He qualifies this statement by saying that passage of time will undoubtedly show some complications, and this we would naturally expect in the naval figures also.

While we have a number of patients with inadequate early treatment, most of these receive later additional treatment. Of the 200 base patients of 1 year or more of infection, 26 received a total of less than 20 injections of arsenicals, plus heavy metal; of these, 12 received less than 15 arsenicals; of these, 2 received less than 9 arsenicals. Of this 26, two were intolerant to arsenicals, but did receive much bismuth. Of the remaining 24, only three experienced serologic relapse. The inadequately treated cases experiencing relapse received additional treatment later to raise their total above 20 arsenicals. Seventeen of these men claim to have had more treatment than their records show, amount of treatment claimed running from 8 to 50 injections more than the records indicate.

SPINALS

Routine checkup spinals on all luetics on the submarine base was started in June 1937, and compilation of the present figures began in December 1937, when enough spinals had been done to insure practically 100 percent completion of this checkup. Men transferred before this date are not included, but every man on duty at the base December 27, 1937, to July 1, 1938, inclusive, is included except two who were transferred before spinals could be done. Men whose records were incomplete received spinal punctures, but the results are not included. None of these showed anything beyond an occasional slight rise in cell count. One hundred and eighty spinal fluid examinations have been done on the base; of these 52 were checked at the Naval Medical School, Washington, D. C., for Kahn and Wassermann, colloidal gold, and globulin; 40 spinal fluids not checked at the medical school were checked by known positive controls.

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Particular effort was made to have the spinals checked at the medical school or run against controls on those men having had serologic blood relapse or showing any positive or questionably positive physical findings. Kahn test, colloidal gold, globulin, and cell count were done at the submarine base. Kahn tests were done with 1.5 cc. of spinal fluid at the medical school and at the base. Wassermann tests, done at the medical school, were done with 1.2 cc. of spinal fluid. Negative spinals done at other stations were not rechecked.

Of the men coming from other stations with 1 year or more of infection, only 29.1 percent had had spinal-fluid examinations.

In Prehn's study of 506 syphilitic abstracts in the Asiatic station, only 77 or 15.2 percent had spinals recorded.[8]

The percentage of spinal punctures done in the Navy is not on a par with the Chicago figures of 30 percent,[1] or the cooperative clinic group figures of 57 percent.[6]

McDonald [12] studied 94 spinal fluids out of 160 cases on the U. S. S. *Lexington*, which is a higher percentage than the figures above, but he does not state how many of these were his work and how many were the run of the mill.

To make spinals a requirement for all syphilitics, we must offer these patients something on the basis of our findings. This we can do, and the staff at the submarine base has had no trouble getting men to submit to spinals. Men under treatment are usually willing and anxious to have spinals even before it is explained to them that it is a necessary guide in their treatment and even though a positive spinal means more intensive or prolonged treatment. Men of longer infection rarely require much persuasion if told that a negative spinal need never be repeated if the blood Kahn remains negative, that a negative spinal is assurance they will never have serious late mental complications, that waiting for physical signs or symptoms means late involvement, that a spinal is the only means of early detection of nervous system involvement, and that the earlier we detect this involvement and start treatment, the more we can do for it.

Stokes [13] states that an absolutely uneventful serology in both blood and spinal fluid throughout the 65-week course, makes a reexamination unnecessary, unless in the ensuing probation, a blood test turns up positive. Moore [7] states that if the original spinal fluid is negative, and there are no clinical or serologic relapses, the spinal need not be repeated until at the end of the post-year of treatment, and if negative then need never be repeated if there are no clinical or serological relapses. In a large series of patients with early syphilis and normal fluids, he had 5 percent develop signs of neurosyphilis, all of a mild type and easily amenable to treatment. In a similar

[12] McDonald, L. E.: U. S. Nav. Med. Bull. 34: 224-234, 1936.
[13] Stokes, J. H.: Clinical problems in syphilis control today. U. S. Pub. Health Supplement No. 3, 1936.

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larger series of patients with late syphilis, clinical neurosyphilis developed in only 0.8 percent. He has never seen tabes or paresis develop in a patient with a previously known negative spinal fluid.

What prognosis can we offer to men with positive spinal fluids? Moore's figures show that in his group II spinal fluids, we can expect 90 to 100 percent clinical and serologic "cure" with adequate treatment, as compared with only 10 to 25 percent with inadequate treatment. In group III (intense—paretic formula) spinal fluids we can expect 60 to 80 percent clinical and serologic "cure" with adequate treatment, as compared with 5 to 10 percent cures with inadequate treatment. Group I spinal fluids (globulin increase and pleocytosis only) do not have enough definite statistical information available for inclusion in these figures.

While spinal puncture is important as a routine procedure in all cases, it is particularly important in the relapsing cases and in Kahn fast cases.

TABLE 11

Percentage of positive spinal fluids

	Wass. fast 6 months	Not Wass. fast	Kahn fast	Serologic relapse	Serologic relapse or Kahn fast	No serologic relapse. Not Kahn fast	Routine check
Cooperative clinic.[a]	42.8 percent,[c] 425 cases	23.2 percent,[d] 1,597 cases					
McDonald			44.4 percent, 18 cases	41.6 percent, 60 cases			23.6 percent, 38 cases
Prehn [e]							16.5 percent 97 cases
Ekblad [b]					26.1 percent, 88 cases	6.2 percent, 112 cases	15.0 percent,[f] 200 cases
Parsons [16]						0.0 percent, 22 cases	

[a] Calculated from data in table 7 of cooperative clinic group studies, U. S. P. H., reprint No. 41.
[b] Submarine base, 200 consecutive Navy cases. 1-19 years infection.
[c] 36.7 percent of these in group I.
[d] 70 percent of these in group I.
[e] All in group I except for 2 of the relapsed cases in group II. Group I cell counts ranged from 5 to 15.

These figures indicate that naval treatment is more effective than civilian, probably due to better control of patients. In Parsons' report on 22 naval cases of 1 to 3 years infection on mapharsen apparently all the cases but two were on continuous treatment, and his 100 percent negative spinals speak highly for either continuous treatment or mapharsen (plus heavy metal), or both.

Further check of the spinals as to type of treatment shows additional accumulation of data in favor of continuous type of treatment over other methods.

[16] Parsons, R. P.: U. S. Nav. Med. Bull. 35: 207-219, 1937.

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TABLE 12

200 consecutive syphilitics. 1–19 years infection

Treatment	Number of spinals			Percentage
	Negative	Group I positive	Group II positive	
Continuous	25	2		7.4
Adequate intermittent	76	11	1	13.6
Inadequate	69	15	1	18.8

Statistics in tables 11 and 12 show the expectancy of cerebrospinal involvement in naval syphilitics on active duty. They do not take into account the naval syphilitics hospitalized or invalided from the service.

The few cases in this series that have shown symptoms, developed them in the third to the ninth year of infection. Working on a basis of 5 years or more of infection, and using the same figures as in the cardiovascular series, there should therefore be approximately 8,552 naval syphilitics of 5–19 years infection.

The Annual Statistical Report for 1936 reports the following cases of dementia paralytica, tabes dorsalis, and neuroretinitis with a service incidence of 0.25 percent.

Dementia paralytica, remaining from last year	10
Dementia paralytica, admitted contributory disability from syphilis	3
Dementia paralytica, readmitted (may be a duplication of one of the above)	1
Tabes dorsalis, remaining from last year	1
Tabes dorsalis, admitted (presumably never diagnosed syphilis before)	1
Tabes dorsalis, admitted contributory disability from syphilis	3
Tabes dorsalis, readmitted (may be a duplication of one of the above)	1
Neuroretinitis (only 1 of 5 cases mentioned as due to syphilis, and some of the others may be)	1
	21
Disposition:	
Returned to duty	8
Diagnosis changed (some of these may have been due to error in original diagnosis)	5
Continued to next year	6
Invalided from the service	2
	21

This report does not take into account men already invalided from the service because of these disabilities. The patients of this group, many representing as they do naval treatment of 10–20 years ago, did not receive adequate treatment according to present-day concepts.

Their extremely low incidence of serious central nervous system involvement may have one or more of the following explanations: (*a*) that syphilitics in civilian life of 5–19 year infection and satisfactory

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outcome are lost track of to such an extent as to make civilian statistics disproportionately dependent upon the unsatisfactory group; (*b*) that excellent physical condition as opposed to average physical condition (e. g.—naval personnel as opposed to average civilian personnel), is a distinct advantage in combating the ravages of syphilitic infection; (*c*) that while naval syphilitics in the 10–19 year group received as a whole inadequate early treatment, they practically all received later additional treatment, that their total treatment probably represents considerably more than that received by the civilian patient, and that this treatment, irregular as it is, does afford considerable protection against serious late syphilitic involvement; (*d*) that neoarsphenamine, the drug used predominately in the Navy in doses of 0.45 gm. and 0.6 gm., is an effective antisyphilitic drug.

Neurological examination of the base patients showed five men with the following positive findings: 2 with weakness of left facial muscles, 1 with pupils reacting slowly to light, 1 with pupils reacting slowly to light plus questionable Rhomberg, 1 with personality change at one time, but apparently normal at present. In addition to the above there were six cases showing knee-jerks slightly exceeding the normal limit found in nonluetics.

DRUGS USED IN NAVY TREATMENT

Bismuth is the heavy metal of choice as judged from the syphilitic abstracts, which is in keeping with its proven superiority over mercury.

The popular arsenical is neoarsphenamine, as shown by the statistics, 5,402 men being treated with neo as compared with 153 arsphenamine, 167 sulpharsphenamine, and 225 with tryparsamide in 1936, when a new drug, mapharsen, made its appearance with 141 cases treated.

A word about mapharsen. Data accumulating in the literature tend to show that mapharsen is an effective drug. It is apparently well tolerated. Accurate data on minor reactions as headaches, slight nausea, etc. are not available since these are so infrequently reported. The prevention of these minor reactions is an important item in securing the cooperation of the patient. This is not as true under military control as in civilian practice, but it is something that should not be overlooked. Of 33 patients under treatment and recently questioned: 4 were intolerant of neo, but took mapharsen easily; 5 greatly preferred mapharsen to neo; 9 preferred mapharsen to neo; 10 were indifferent to which drug they took; 3 preferred neo; 2 were intolerant of mapharsen but tolerated neo easily. The procedure at the base is to let the patient have his choice of drug.

No particular preparation is required before injections except that the men are instructed to have no breakfast other than a piece of

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toast and a cup of coffee. A carthartic is not compulsory. Men are told to try it to see if they feel better when they use it, but very few continue it.

DIAGNOSIS AND INSTITUTION OF TREATMENT

Two of the submarine base records were discarded because of obvious error in diagnosis. One of these had one positive blood immediately after an attack of malaria which will give 15 percent positive bloods [15] and received two injections of neo as his total treatment; all bloods since have been negative, and physical and spinal fluid 13 years later are negative. The other was given one injection of neo on the strength of a penile sore, negative darkfield, negative blood, no secondaries and everything else negative. Bloods since have all been negative, and physical 10 years later is negative. Both of these men illustrate the danger of establishing diagnosis and instituting treatment on insufficient data.

The other side of this problem is illustrated by two men diagnosed seronegative primary by darkfield examination and treatment instituted on Asiatic station, who had their treatment stopped by a medical officer on the west coast because their healing lesions did not look like chancres.

Both men shortly afterwards broke out with florid secondaries and fell heir to the grave prognosis and extended treatment of relapsing cases. Therefore, after the diagnosis has once been made and treatment started, that treatment must be carried out with rigor even through the diagnosis may appear doubtful.

POST TREATMENT PROBATION

United States Public Health reprint No. 63 from Veneral Disease Information summarizes probation:

> for those who demand the absolute in assurance; for those whose timidity makes repeated serologic and clinical examination the only escape from syphilophobia; for those who have been given inadequate or desultory treatment in the first year or two of the infection; and for those women who contemplate pregnancy or become pregnant, indefinitely prolonged or repeated observation is necessary. On the other hand, for those who can accept a reasonable and in fact high probability of "cure" after strict adherence to an effective and especially continuous treatment regimen in the first 2 years, and whose lives would be needlessly shadowed or disturbed by the exactions of observation, 5 years of probation after treatment ends is sufficient. Special situations, such as definite relapsing tendencies observable during treatment or marked predisposition to serious types of involvement early may require special dispositions. All patients should be informed that a cardiovascular check should be performed by a competent observer in the 5- to 10-year period because of the as yet unevaluated status of this group of complications; and that if conception be contemplated, the woman's status should be

[15] Hazen, H. H.: Serodiagnosis of syphilis. U. S. Pub. Health, Supplement No. 3, 1936.

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reviewed; for of 207 mothers who had had syphilis but who were seronegative, 8.2 percent gave birth to children with positive blood Wassermann reaction at birth—and the proportion might have been higher later. Therefore, potential cardiovascular disease and the transmission of syphilis to the unborn child remain the two intrinsic justifications for prolonged and repeated observation after prompt adequate treatment for early syphilis.

This summary will hold for naval men with the one exception that we need have little fear of creating any phobia by occasional blood checks throughout their entire naval career.

SUMMARY

1. Navy antisyphilitic treatment has shown a definite improvement.

2. A standard of antisyphilitic treatment is given: Continuous treatment, to be carried on until 25–30 arsenicals, plus appropriate heavy metal, have been given after negative serology.

3. The earlier the blood Kahn reverses, the better the prognosis.

4. Seventy-five percent of serologic relapses will occur by the second year after discontinuation of treatment and 95 percent by the fourth year.

5. The continuous treatment system is definitely superior to other treatment systems as practised in the Navy, but any system, if continued in, will ultimately give good results, and especially so with adequate post-negative serologic treatment.

6. Twenty-four and four-tenths percent of syphilitics in the Navy are diagnosed in the seronegative primary stage.

7. Symptomless infection in the male, probably not over 3–5 percent, is not as high as reported in civilian figures.

8. The Navy has 2.7 percent reinfections as judged by criteria proposed by the author.

9. The incidence of cardiovascular syphilis in the Navy is low.

10. Only 15 to 30 percent of syphilitics in the Navy receive spinal fluid examinations.

11. The incidence of syphilitic involvement of the central nervous system in the Navy is low.

12. Suggested post-treatment probation for syphilitics in the Navy.

(*a*) Spinal fluid check 1 year post-treatment. If this is negative and there are no clinical or serological evidences of relapse it need never be repeated.

(*b*) Cardiovascular check in the 5 to 10 year post-treatment period.

(*c*) Occasional blood checks throughout naval career.

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CARDIOVASCULAR SYPHILIS [1]

By Commander W. H. H. Turville, Medical Corps, United States Navy

Cardiovascular syphilis is essentially syphilitic aortitis and its complications such as aortic insufficiency, stenosis of the coronary orifices and aneurysm. The occurrence of syphilitic myocarditis is such a rarity that it will not be considered in this paper.

The connection between syphilis and cardiovascular disease was first noted by Paré in 1575, who suspected syphilis as a cause of aneurysms. Lancise in 1728 spoke of a "venereal aneurysm" and Morgagni in 1761 produced evidence of syphilis as a cause of aneurysm.

The real story of cardiovascular syphilis however began in 1876 when Welch, an English pathologist, described for the first time the essential macroscopic and microscopic features of syphilitic aortitis. His publication was strongly contested and then was all but forgotten.

Ten years later Dohle published a more comprehensive report on the disease, so that he is often given credit for the first work on syphilitic aortitis. Dohle's work served to arouse interest in the subject again and by 1903 there was a rather general acceptance of syphilitic aortitis as a specific pathologic entity.

The demonstration of the *Treponema pallidum* in sections of syphilitic aortas by Reuter and Schmorl in 1907, by Wright and Richardson in 1909, and the introduction of the Wassermann test with its high percentage of positive reactions in these cases, were further milestones in establishing the knowledge of cardiovascular syphilis upon a firm basis.

In the United States about 10 percent of all cases of organic heart disease are due to syphilis. Approximately 5 percent of all patients who come to autopsy in general hospitals show evidence of cardiovascular syphilis, and of known cases of syphilis that come to autopsy, involvement of the cardiovascular system is noted in from 55 to 86 percent of the cases. One third of the sudden deaths due to heart disease are the result of cardiovascular syphilis.

It is believed that upwards of 40,000 deaths from cardiovascular syphilis occur in the United States annually. Vondelehr [2] has estimated that each death represents a loss of from 19 to 23 years of life.

In a recent survey [3] it was shown that the incidence of cardiovascular syphilis is greater among those engaged in manual labor than among those engaged in sedentary occupations, and that physical exertion imposed by occupation influences directly the development of the graver forms of cardiovascular syphilis.

[1] Read before the Norfolk County Medical Society, Norfolk, Va., November 15, 1937.
[2] Morgan, H. J.: Ann. Int. Med. 11: 469–473, 1937.
[3] Cochems, K. D., and Kemp, J. E.: Am. J. Syph., Gonor. & Ven. Dis. 21: 408–412, 1937.

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Stokes[4] states "from the pathologic physiology of syphilis it is difficult to understand how the heart and great vessels can ever escape involvement."

The early recognition and proper treatment of syphilis decreases the percentage of cases of cardiovascular syphilis. Aneurysm is becoming less frequent because of better antiluetic therapy. At the Massachusetts General Hospital only 61 cases of aneurysm were diagnosed in the decade of 1924 to 1934, this in spite of the widespread use of x-ray in cardiovascular examinations, while in the previous decade 131 cases of aneurysm were diagnosed.

When a regurgitant aortic lesion, a hugely dilated heart or an aneurysm is diagnosed in a syphilitic case, somebody has failed in carrying out the proper antiluetic treatment for that individual.

It was formerly taught that there is a long latent period between the primary infection and the development of cardiovascular syphilis, usually 15 to 20 years. This may be true of some cases, but it is now known that syphilitic involvement of the cardiovascular system may and does occur soon after the primary invasion by the treponema. It is true that as a rule symptoms are not manifested for years after the primary involvement, but the process is developing pathologically and if one waits until symptoms develop, then it is too late for treatment to be of much benefit to the patient. In institutions where large numbers of syphilitics are treated and recourse is taken to the frequent use of x-ray in these cases, one frequently finds x-ray evidence of uncomplicated syphilitic aortitis early in the course of the disease that cannot be recognized by any other means of examination.

Ten percent of the patients in whom an uncomplicated syphilitic aortitis was detected in the cooperative clinical group[5] material had their infection for less than 5 years.

Cardiovascular syphilis occurs at all ages but it is observed most frequently symptomatically in the fifth and sixth decades of life and predominantly among males. The ratio of males to females is about 5 to 1. In a recent survey[5] of 326 cases 9 percent of the cases occurred in patients under 30 years of age.

It is 2 to 3 times more prevalent among negroes than among whites. This may be explained by the prevalence of syphilis in negroes, lack of adequate treatment and also they are more apt to do heavy manual labor.

In cardiovascular syphilis one is dealing essentially with disease of the thoracic aorta and especially the root of the aorta, that is the first 5 centimeters above its origin. It is here that we have the aortic ring, aortic valve cusps and the origin of the coronary arteries.

[4] Stokes: J. H.: Modern Clinical Syphology, second edition, Saunders, Philadelphia, Pa., 1934.

[5] Cooperative clinical studies in the treatment of syphilis. U. S. Pub. Health, Ven. Dis. Info. 17: 91-105, 1936.

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The next most frequent involved site is the ascending aorta, then the arch and lastly the descending aorta.

The nearer the infiltrative process is to the aortic ring, the graver is the situation of the patient and the more certain is the development of aortic insufficiency and myocardial injury. On the other hand the higher up the ascending portion of the aorta or the arch itself is involved, the more probable is the development of aneurysmal change through the effect of an intact aortic valve in maintaining diastolic pressure against a weakened aortic wall. Thus it comes about that disease of the root of the aorta is in general of graver prognosis than is disease of the upper ascending or arch of the aorta.

When an individual is infected with syphilis, the *Treponemata pallida* multiply rapidly in the chancre and are widely distributed throughout the body by means of the blood stream and the lymphatic system. Thus cardiovascular syphilis may occur as a result of invasion through the blood vessels and also through the lymphatic system by way of the intrathoracic lymph nodes. The infection is disseminated through the thoracic duct, intrathoracic lymph nodes to the small lymph vessels that accompany the vasa vasorum of the aorta. Nature has endowed the aorta very abundantly with vasa vasorum, hence the keystone of the circulatory system is endangered by the heaviest burden of the syphilitic infection. It is believed that the organisms gain entrance into the aorta by way of the lymphatic vessels that accompany the vasa vasorum and that the adventitia of the aorta becomes involved first, resulting in periaortitis. The process extends to the media producing a mesaortitis and finally the intima becomes the seat of the disease. The intimal changes are quite characteristic becoming evident as irregular patches of grayish or pinkish discoloration, at times slightly indented and associated with linear scars. The intima is frequently thickened and secondarily becomes the seat of an atherosclerotic process, especially in those past middle life.

The inflammatory process of syphilis results in a reparative fibrosis, in the early stages revealing the infiltration of many round cells and is soon succeeded by a fibroblastic reaction, a process that tends to heal with considerable scarring and deformity.

Formerly great stress was placed on so-called syphilitic myocarditis, but studies in recent years have indicated that actual involvement of the cardiac muscle by syphilis is a relatively unusual finding. The heart becomes hypertrophied and may often fail and result in death, but these conditions are the result of the primary changes in the aorta.

The occurrence of gummas in the heart muscle is rare. They are found in only about 2 percent of the cases of cardiovascular syphilis at autopsy. Gumma as a cause of heart block is greatly overrated.

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Pathologically, syphilitic aortitis is frequently overlooked at the autopsy table, especially in old people, due to atheroma being superimposed on the luetic aorta and clouding the typical lesions of syphilis.

In the development of aortitis, areas of necrosis of the media are produced and the elastic tissue is replaced by fibrotic tissue. This loss of elasticity results in stretching of the aorta behind the aortic ring, and a lack of adequate recoil to the alternating hemodynamic forces. While the aortic cusps are competent they close more forcefully under the increased intraaortic pressure, this gives rise to a tympanitic accentuation of the second heart sound which is heard over a localized zone at the second right interspace. As the changes in the media progress, dilatation of the aorta occurs producing a rough systolic murmur without a thrill that may be heard over the same area. Further progression of the disease process causes a separation of the commissures of the aortic leaflets due to the dilatation of the aortic ring. When the commissures themselves are invaded these structures become widened and aortic insufficiency results. A further deformity may result from the process of cicatrization. A weakening of the ring resulting from the involvement of the leaflets, particularly at their points of origin, tends to occur, so that marked degrees of aortic insufficiency are often present. This lesion, aortic insufficiency, has a marked effect on the heart causing an enormous increase in the load of the left ventricle, so that this chamber soon becomes the seat of a progressively increasing hypertrophy and, consequently dilatation with cardiac failure occurs. Interestingly, hypertrophy of the heart is not limited to the left ventricle, but all the chambers participate to some extent, though not to the same degree as the left ventricle.

The orifices of the coronary arteries, which are located in the root of the aorta just behind the right and left anterior aortic cusps are another important part of the first portion of the aorta. Frequently the syphilitic process has so involved this portion of the aorta that these small openings become definitely narrowed and impaired by the fibrotic process and their lumens are so reduced that a small bristle can be introduced only with great difficulty. This lesion gives rise to disturbances in function identical with those that occur in sclerosis of the coronary vessels, namely, the anginal syndrome and paroxysmal dyspnoea. The heart muscle responds to this lesion in the same manner as it does to gradual obliteration of the coronary arteries; namely by the occurrence of myofibrosis, which is the lesion that results from chronic deprivation of the coronary circulation.

Infarct of the heart is a very rare complication following stenosis or occlusion of one or both coronary orifices, the result of a syphilitic process. This may be explained by the fact that the stenosis or occlusion of an orifice is slow in developing, which permits the establishment of a collateral circulation through the Thesbian veins,

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arterioluminal and the arteriosinusoidal vessels. It is very rare to see the coronary arteries themselves involved in the syphilitic process, the lesions usually terminate abruptly at the points of origin of the coronary arteries.

Another important lesion resulting from cardiovascular syphilis is aneurysm. The aneurysm may be fusiform or saccular, and it may be situated in the ascending aorta, in the arch, in the descending thoracic aorta or lastly in the abdominal aorta. Unless aortic insufficiency, or stenosis of the coronary orifices is present, the presence of an aneurysm causes little or no effect on the heart. The development of aortic insufficiency, before dilatation of the aorta occurs, often prevents the formation of an aneurysm by relieving the intra-aortic pressure.

In a recent survey of 307 cases of cardiovascular syphilis,[5] 72 percent had a positive blood Wassermann reaction. In a survey of 191 cases,[5] 49 percent had a positive Wassermann of the spinal fluid. Among young and middle aged individuals with evidence of cardiovascular syphilis, involvement of the central nervous system should always be suspected. The corollary is also true especially for those in the middle aged group. Healey [6] reported that 50 to 60 percent of paretics gave evidence of cardiovascular syphilis clinically, and that about 75 percent of the autopsies gave the same evidence pathologically.

The *symptoms* of cardiovascular syphilis are not characteristic and are the same as those which occur with the various types of cardiopathy. The outstanding symptoms are pain and dyspnoea. There may be a total absence of symptoms until such complications as aortic insufficiency, stenosis of the coronary orifices or aneurysm appear.

Aortitis: There is no satisfactory symptomatic picture of uncomplicated aortitis.

The possibility of aortitis in any patient with syphilis should ever be present in the physician's mind, as the aorta is involved more frequently than any other organ. It does not matter whether the evidence is in the history, in the presence of some other syphilitic lesion or in a positive Wassermann or Kahn test. If the patient is syphilitic, disease of the aorta must be considered until it is excluded.

The principal symptoms and signs of uncomplicated aortitis in the records of cases from the cooperative clinical groups [5] given in order of their importance are as follows:

(1) X-ray evidence, both teleroentgenographic and fluoroscopic evidence of aortic dilatation. At this hospital all cases of syphilis of one or more years duration are examined teleroentgenographically and if there is any suspicion of aortic involvement either in the anteroposterior or oblique views, than the patient is examined fluoroscopically. During the past 2 years several cases have been picked up in this manner that would have escaped otherwise. In approximately

[6] Healey, F. H.: Lancet 2: 350–353, August 18, 1934.

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one-third of the cases of aortitis diagnosed on the medical service in the past 2 years the interval between the primary infection and the discovery of aortitis was 8 years of less. In 1 case the interval was 3 years.

(2) A tympanitic bell like tambour accentuation of the aortic second sound.
(3) A history of circulatory embarrassment.
(4) Increased retromanubrial dullness.
(5) Progressive cardiac failure.
(6) Substernal pain.
(7) Paroxysmal dyspnoea.
(8) Systolic murmur in the aortic valve area.

The presence of three or more of these symptoms and signs in a proved case of syphillis is considered justification for the diagnosis of uncomplicated syphilitic aortitis.

Aortic insufficiency is a late sign of cardiovascular syphilis, and in the majority of instances, marks the beginning of the end. The importance of syphilis as the main cause of pure aortic insufficiency is now generally recognized. The detection of aortic insufficiency without evidence of other valve lesions in the adult or middle aged individual should always suggest the possibility of a syphilitic etiology.

Aortic insufficiency ultimately results in dyspnoea, occurring first on undue effort and later may present the well known syndrome of congestive heart failure. The physical findings of this lesion are readily identified, namely the presence of a loud, blowing diastolic murmur, best heard over the aortic area, or over the sternum, the water-hammer and capillary pulses, the pistol-shot sounds over the arteries and Duroziez's sign. Cardiac enlargement occurs and is particularly manifest in the left ventricle. An increase in pulse pressure also occurs by vitrue of elevation of the systolic blood pressure, but particularly because of the marked reduction in the diastolic pressure.

The presence of cardiac enlargement in a case of syphilitic aortitis should cause one to suspect that aortic insufficiency is also present, as cardiac enlargement is not a part of the picture of uncomplicated aortitis or aneurysm.

Stenosis of the coronary orifices.—Ostial stenosis, usually occurs as a part of the syphilitic involvement of the aorta and rarely does it appear alone. Typical anginal pain, increased by exertion or excitement is the characteristic symptom, although at times the pain may occur independently of either. Angina occurring in a patient under 40 years of age with syphilitic aortitis or syphilitic aortic insufficiency, constitutes strong evidence in favor of ostial stenosis.

Paroxysmal dyspnoea in cases of aortitis in the absence of aortic insufficiency points toward the presence of ostial stenosis. The close relationship between ostial stenosis and sudden death is apparent. In a series of 15 cases of stenosis of the coronary arteries sudden death occurred in 10 cases.[7]

[7] Pincoffs, M. C., and Love, W. S., Jr., Am. J. Syph. & Neurol. 18: 145-153, 1934.

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Narrowing of the coronary orifices occurs frequently without the presence of distinctive physical signs. The occurrence of the anginal syndrome in a case of proved or suspected syphilis, should at once direct suspicion toward this possibility.

The heart does not become enlarged unless the lesion is complicated by aortic insufficiency or some independent and unassociated cardiac lesion in itself capable of producing hypertrophy.

The x-ray does not reveal any positive findings. The electrocardiogram, however, frequently shows those abnormalities encountered in obliterative disease of the coronary arteries, namely T-wave negativity and bundle branch block.

Aneurysm.—The symptoms attending thoracic aneurysm are variable and depend largely on the encroachment of the pulsatile mass on surrounding structures. Pain in the mid portion of the thorax may occur with or without relation to effort, frequently being projected through to the back and usually being of longer duration than that which occurs in the anginal syndrome. Obstruction of the esophagus may cause dysphagia, obstructive dyspnoea may occur from tracheal compression, and hoarseness and brassy cough from pressure on the recurrent laryngeal nerve may also occur. The heart does not become involved in aneurysm unless aortic insufficiency, ostial stenosis or obstruction to the great vessels occurs.

The signs of aneurysm of the thoracic aorta vary widely. Instances are met with in which positive evidence of its presence is only revealed by the x-ray examination. Hence no cardiovascular examination is complete without an x-ray examination. Generally speaking unequal radial pulses in a middle aged person mean luetic involvement somewhere in the aorta. In a series of cases reported by Cole and Usilton positive blood Wassermann reactions were obtained in 90 percent of these cases.

Aneurysm has been mistaken most frequently for nonaneurysmal tumor and pulmonary tuberculosis. Visible or palpable pulsation, diastolic shock and accentuated aortic second sounds do not occur in solid mediastinal tumor.

Prognosis in general in cases of cardiovascular syphilis is grave. This is due to the fact that the cardiac symptoms and signs are insidious in their onset, with the result that the lesion is frequently moderately advanced or even well advanced before the true nature of the condition is recognized.

When the cardiovascular lesion has become a mechanical barrier, impairing the circulation, it is beyond the stage of curability, although often the judicious and cautious employment of antiluetic therapy will ameliorate the symptoms and aid in the prolongation of life. The statistical data reported by the cooperative clinical group [5] showed

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that in cases that were adequately treated after a diagnosis of cardiovascular syphilis was made, there was an average increase in the duration of life from 34 to 85 months in uncomplicated aortitis, from 40 to 55 months in aortic insufficiency, and from 37 to 75 months in aneurysm.

The presence of stenosis of the coronary orifices, on the average, shortens the duration of life after symptoms have appeared far more than does aortic insufficiency. Ostial stenosis is the most frequent cause of sudden death in cardiovascular syphilis.

The striking down out of a clear sky of an apparently healthy man in the prime of life, previously infected with syphilis, and going into cardiac failure and death within two to four years is the usual history.

Treatment of cardiovascular syphilis should be directed toward its prevention by the thorough treatment of the syphilitic patient in the early stage of the infection. It has been shown by the cooperative clinical group [5] that when patients with early syphilis are adequately and regularly treated, there is practically no cardiovascular syphilis.

Once cardiovascular syphilis has been recognized in a patient, then he should be treated primarily as a heart case, bearing in mind the etiological, anatomical and functional factors in the individual case.

When cardiovascular syphilis has developed the aims of treatment are not the radical cure of the syphilitic infection, or even the restitution of the damaged structures to anatomic integrity. This is impossible, because the destroyed elastic tissue cannot be replaced, or can the distorted aortic valve cusps be remade. All that one can hope to accomplish is to bring about healing of the active inflammatory process and its replacement by fibrous tissue, prevent further involvement of the diseased structures, and to compensate so far as possible for the mechanical damage done to the cardiovascular mechanism. Thus in the ultimate analysis the aims of treatment are to relieve distressing symptons and to prolong life.

A regimen directed toward the removal of stresses and strains to lighten the burden on the heart should be individualized in each case. It may mean moderate physical restrictions on the one hand or complete rest in bed on the other.

When cardiac failure is present, the usual procedures employed in the treatment of this condition should first be instituted, and antiluetic treatment should be deferred until the reestablishment of function has been achieved. Cardiac decompensation is an absolute contraindication to antiluetic therapy, and the history of an earlier period of cardiac failure should lead to utmost caution in the use of any antiluetic treatment.

Evidence of involvement of the orifices of the coronary arteries is an absolute contraindication to the use of any arsenicals, because of

[5] Cole, H. N., and Usilton, L. J.: Arch. Int. Med. 57: 910-918, 1936.

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the danger of producing therapeutic shock, the so-called Jarisch-Herxheimer reaction. This consists of a flare-up, or intensification of the syphilitic lesions a few hours after the first injection of an arsphenamine product causing an edematous swelling of the syphilitic lesions, and if the coronary orifices are involved it may result in occlusion of the mouths of the coronary arteries and sudden death.

All cases of cardiovascular syphilis in which the arsenicals are used should be given a prolonged preliminary course of a heavy metal and iodide for a period of several months before the arsenical treatment is begun.

Experience has shown that arsphenamine (606) should not be employed.

Neoarsphenamine may be used. Better results are obtained with small doses of the arsenicals than with large doses. The initial dose should be small and the maximum should not exceed 0.3 gm. The average duration of life in those treated with small doses of the arsenicals in the cooperative clinical group cases of aortitis was 20 months longer than in the case of those who had been treated with large doses.

The data suggest that in treating uncomplicated syphilitic aortitis it is wise for the physician to limit his use of arsenicals to small doses in an effort to prolong life. It is not possible to overwhelm the syphilitic process in the aorta by the use of large doses of the arsenicals. Moreover the unwise use of large doses may bring on what Wile has termed a "therapeutic paradox." This is especially true if the arsenical is used at the beginning of treatment. There is at first a temporary improvement in the patient's condition, but it may eventually result in so much distortion of the aortic walls and leaflets that an even more serious condition will remain than that from which the patient suffered originally. With the use of smaller doses there is more opportunity for a gradual healing sclerosis of the vessel walls, or as Stokes [4] very aptly states "A progressive disability is exchanged for a static one."

Young people may be treated more actively than may middle aged or old people. In old people the associated arteriosclerotic changes in the aorta and coronary arteries in itself indicate caution in the use of any arsenicals.

During the past year we have used Mapharsen at this hospital in the treatment of our cases of cardiovascular syphilis. Although the number of cases has been too small to draw any definite conclusions, we believe that our results of treatment are better, and at least we have not had any reactions.

SUMMARY

1. Involvement of the aorta in cardiovascular syphilis begins soon after the appearance of the primary lesion, but in the past its recognition has been delayed by the late development of symptoms.

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2. Early diagnosis of uncomplicated syphilitic aortitis is possible in many instances before the development of aortic insufficiency or aneurysm and properly directed treatment is often successful in arresting the disease.

3. In addition to symptomatic care, preferable treatment consists of a preliminary course of iodide and a heavy metal, followed by cautious use of arsenicals in small doses.

4. Shock must be avoided at all times.

EXAMINATION OF THE SPINAL FLUID IN SYPHILIS

RESULTS OF INITIAL EXAMINATION IN 140 CASES

By Lieutenant E. M. Wade, Medical Corps, U. S. Navy

For over 20 years it has been recognized that involvement of the central nervous system in syphilis occurs early in the course of the disease, probably within the first year, unless influenced by treatment.[1 2] It is considered that a negative spinal fluid found at the end of the first 6 months of treatment probably will not become positive as long as the blood remains negative.[3] Systematic examination of the spinal fluid in syphilis will reveal a variable percentage of cases with positive findings, but without clinical symptoms or abnormal signs, i. e., asymptomatic neurosyphilis. The presence of a positive spinal fluid in early or late syphilitics who show no objective neurological abnormalities is, nevertheless, of grave prognostic import.[4] Generally speaking, the ultimate damage to the patient is roughly proportional to the intensity of the spinal fluid changes, unless the patient is given intensive and adequate antineurosyphilitic treatment. Mention has been made of tabes dorsalis due to syphilis without positive spinal fluid findings. Such a condition is rare, and to support such a diagnosis it is necessary to consider the most thorough clinical investigation together with autopsy finding in each case to rule out the possibility of atypical pernicious anemia, spinal cord tumors, and other pathological processes capable of producing tabetic symptoms.

The desirability of early routine spinal fluid examination in every case of syphilis was further brought to the attention of the readers of this Bulletin by its editor in 1931,[5] Aston and Dusinberre in 1932,[6] and by Parsons,[7] and by Jensen and Wheelis[8] in 1934.

[1] Craig, C. F.: The Wassermann Test. St. Louis, C. V. Mosby Co., p. 206, 1918.

[2] Moore, J. E.: Studies in Asymptomatic Neurosyphilis, Bul. John Hopkins Hosp., 33:231, 1922.

[3] O'Leary, P. A., Cole, H. N., Moore, J. E., Stokes, J. H., Wile, U. J., Parran, T., Vonderlehr, R. A., and Usilton, L. J.: Cooperative Clinical Studies in the Treatment of Syphilis: Asymptomatic Neurosyphilis, Ven. Dis. Info. 18: 45–65, 1937.

[4] Moore, J. E.: Asymptomatic Neurosyphilis, J. A. M. A. 95:1637, 1930.

[5] Notes and comments: Asymptomatic Neurosyphilis, Nav. Med. Bul. 29: 263–265, 1931.

[6] Aston, M. J., and Dusinberre, R. K. Y.: Spinal Fluid Examination in Syphilis, Nav. Med. Bul. 30: 46–49, 1932.

[7] Parsons, Robert P.: Syphilis in the Navy, Nav. Med. Bul. 32: 381–391, 1934.

[8] Jensen, Harold L., and Wheelis, J. M.: Should we Standardize the Treatment of Early syphilis? Nav. Med. Bul. 32: 430–441, 1934.

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INDICATIONS AS TO WHEN TO EXAMINE THE SPINAL FLUID

Early syphilis.—In cases of early syphilis the cooperative clinical studies recommend that tests of spinal fluid should be made as follows:[2]

1. Tests should be made early in the course of treatment and certainly by the sixth month of treatment. If the cell count is above normal and all other factors are normal, the test should be repeated at the completion of the course of treatment. If the first examination of spinal fluid is positive, subsequent tests should be made at intervals of 3 months to note the trend toward either the mild or the more severe (paretic) types. If the first report is negative, subsequent reexaminations may be warranted under certain conditions.

2. If the blood reverses to negative during treatment and relapses to positive while treatment is continued, a test of the spinal fluid should be made.

3. If the patient neglects treatment but later returns for it, the spinal fluid should be examined even though the blood test has remained negative. If the patient presents symptoms denoting meningeal involvement, such as headache, dizziness, nausea, vomiting, diplopia, etc., the spinal fluid must be tested.

4. This study clearly indicated that a patient with early syphilis who is treated adequately and regularly and who at the sixth month of treatment is found to have a negative spinal fluid, may be reassured that the spinal fluid will not become positive as long as the blood Wassermann remains negative. However, before the completion of treatment the spinal fluid should be reexamined.

5. Although the blood becomes negative after treatment is started and remains so throughout the entire course of treatment, the spinal fluid should be examined before the patient is placed on observation or parole.

Late syphilis.—In cases of late syphilis a test of spinal fluid should be made as follows: [3]

1. A test should be made early in the course of treatment. In this survey it was found that if the disease is 4 years or more in duration, a negative test is evidence that in more than 99 percent of the cases in which patients have received treatment the spinal fluid will not subsequently become positive. If, however, the spinal fluid is found to be positive, subsequent reexaminations are necessary at intervals of 6 months. These repeated tests will show that the trend is toward the negative, or that the tests are persistently the same, or that the condition is progressing unfavorably toward the paretic type. This trend is a guide to the results of treatment and may be an indication for a change in the therapeutic program.

2. In a case of late syphilis in which the original examination of spinal fluid is negative a relapse in the blood Wassermann does not indicate that the spinal fluid has become involved. In cases of early syphilis, however, such a blood Wassermann is of more significance and demands another examination of the spinal fluid. However, in a case of either early or late syphilis in which asymptomatic neurosyphilis has been demonstrated a relapse in the blood Wassermann from negative to positive warrants another test of spinal fluid.

3. In cases of asymptomatic neurosyphilis, repeated examinations of the spinal fluid are essential for the proper evaluation of treatment. Although the blood and spinal fluid both become negative, the spinal fluid should be reexamined the first year and again the third year after the cessation of treatment.

In a study of the spinal fluid findings of 5,293 cases of syphilis which were collected from a series of 75,000 patients with syphilis in all of its manifestations, O'Leary et al. report [3] 39.9 percent positive find-

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ings with associated clinical signs of neurosyphilis, whereas in an additional 13.5 percent asymptomatic neurosyphilis was present. Since only 7 percent of the series of 75,000 patients had received examination of the spinal fluid during the 2-year observation period, it is probable that the percentage of positive fluids reported is considerably higher than if the entire group had been considered.

In 1934, McDonald reported a series of 39 cases of syphilis with serological relapse wherein 51.4 percent, showed positive spinal fluid findings.[9] He also reported in 1936 a series of 116 spinal fluids from patients known to have had syphilis, in which 36.2 percent were found to have abnormal findings.[10] The editor of this Bulletin in 1936 [11] mentioned 47 cases with a history of syphilis in the Navy which were given a spinal fluid examination by several laboratories. Kahn and colloidal reactions were negative in all instances. Occasional specimens were reported plus-minus globulin. In only two instances were cell counts over 10 (1–14; 1–17).

During a period of slightly more than 1 year, 140 consecutive cases of syphilis with at least one examination of the spinal fluid each were observed by the writer on board a battleship. In this series there were 8 (5.71 percent) cases in which the initial examination of the spinal fluid revealed abnormal findings. In 7 instances the neurosyphilis was asymptomatic and was detected by routine spinal puncture. The eighth case developed symptoms and signs of dementia paralytica in 1936 without a previous diagnosis of syphilis. According to the modern concept of treatment for primary and secondary syphilis, all of these cases of asymptomatic neurosyphilis had received irregular and inadequate early treatment and in only 1 instance had the spinal fluid been examined in the first year of the disease. A self-explanatory brief summary of each case based on information contained in the individual's health record follows:

CASE REPORTS

Case 1.—F. X. C., white, male, born December 1898. History of gonococcus infection, urethra, 1921. In July 1923 there was an ulcer on the penis, but dark-field examinations were negative. On March 20, 1925, and April 2, 1925, the Wassermann reaction was reported one plus. On May 7, 1925, the Wassermann reaction was reported four plus and the following treatment was given:

May 7 to June 30, 1925.—Arsenical, six injections, drug and total amount unknown. Heavy metal, eight injections, drug and total amount unknown.

October 8, 1925.—Wassermann reaction negative.

October 26 to December 9, 1925.—Arsenical, six injections, drug and total amount unknown. Heavy metal, eight injections, drug and total amount unknown.

[9] McDonald, L. E.: A Systematic Study of 303 Cases of Syphilis, Nav. Med. Bul. 32: 497–506, 1934.

[10] McDonald, L. E.: Some Aspects of the Treatment of Neurosyphilis in the Navy, Nav. Med. Bul. 34: 224–234, 1936.

[11] Notes and comments: The Spinal Fluid in Syphilis, Nav. Med. Bul. 34: 260, 1936.

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April 8 to May 17, 1926.—Arsenical, seven injections, drug and total amount unknown. Heavy metal, seven injections, drug and total amount unknown.

PROGRESS.—February 1, 1927, the Wassermann reaction was negative.

November 2, 1927, the Kahn reaction was plus minus and subsequent blood Kahn reactions were reported negative March 1928, September 1929, February 1931, December 1935, and January 1937.

May 3, 1937, a routine examination of the cerebrospinal fluid was reported as follows: Many red cells, Kahn two plus, globulin increased, gold curve 0122343210, pressure 20 mm. mercury.

No subjective symptoms. Physical examination negative. Patient has recently received tryparsamide intravenously and sodium iodobismuthite compound intramuscularly with complete reversal of spinal fluid findings.

COMMENT.—Inadequate early treatment and poor serological follow-up including *first examination of spinal fluid made approximately 12 years after first antisyphilitic treatment.*

Case 2.—C. E. Z., white, male, born December 1900. No history of primary lesion. In June 1925 he developed a pustular rash, mucous patches, and adenopathy. The Wassermann reaction on June 18, 1925, was two plus. He was given the following treatment:

June 1925 to March 1927.—Neoarsphenamine, 27 injections, total amount unknown. Mercury salt, 35 injections, type and total amount unknown.

November 1925.—Wassermann reaction negative.

January to June 1928.—Neoarsphenamine, 6 injections, total amount unknown. Mercury salt, 7 injections, type and total amount unknown.

January 1929.—Kahn reaction two plus.

March to November 1929.—Neoarsphenamine, 11 injections, total amount unknown. Mercury salt 19 injections, type and total amount unknown.

April to August 1930.—Neoarsphenamine, 11 injections, total 4.95 grams. Mercury salt, 19 injections, type and total amount unknown.

September 1930.—Kahn reaction one plus.

November 1930 to January 1931.—Neoarsphenamine, 11 injections, total amount unknown. Mercury salt, 9 injections, type and total amount unknown.

April 1931.—Kahn reaction three plus.

May 1931.—Kahn reaction negative.

August 1932.—Kahn reaction three plus.

August to November 1932.—Neoarsphenamine, total 4.3 grams, number injections unknown. Bismuth salt, total 0.9 grams, type and number injections unknown.

February 1933.—Kahn reaction three plus.

February to May 1933.—Neoarsphenamine, total 4.08 grams, number injections unknown. Bismuth salt, 6 injections, type and total amount unknown.

December 1933 to November 1934.—Neoarsphenamine, 10 injections, total 4.5 grams. Bismuth salt, 24 injections, type and total amount unknown.

February 1935 to July 1935.—Neoarsphenamine, 20 injections, total 8.4 grams. Bismuth salt, 10 injections, type and total amount unknown.

September 1935.—Kahn reaction four plus.

September to December 1935.—Neoarsphenamine, 10 injections, total 4.35 grams. Bismuth salt, 10 injections, type and total amount unknown.

March 1936.—Kahn reaction four plus.

April to July 1936.—Sodium iodobismuthite compound, 17 injections, total 4.08 grams.

PROGRESS.—August 1936 a routine examination of the cerebrospinal fluid was reported as follows: Cells 9, Kahn four plus, globulin heavily increased, gold curve 5455455400. The blood Kahn reaction was plus minus. There were no sub-

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jective complaints. Physical findings were negative. Patient has received tryparsamide and malaria therapy with some improvement in spinal fluid findings.

COMMENT.—Inadequate early treatment and poor serological follow-up including *first examination of spinal fluid made 11 years after first antisyphilitic treatment.*

Case 3.—O. N. G., white, male, born June 1902. Without history of primary or secondary lesions, the blood Kahn reaction was found to be three plus on September 9 and 16, 1926. The following antisyphilitic treatment was administered:

September to October 1926.—Arsenical, 7 injections, type and total amount unknown. Also mercury rubs and potassium iodide by mouth, amount unknown.

December 13, 1926.—Kahn reaction one plus.

December 21, 1926 to November 18, 1927.—Neoarsphenamine, 12 injections, total amount unknown. Mercuric succinimid, 12 injections, total amount unknown.

October 10, 1927.—Kahn reaction negative.

March to October 1928.—Neoarsphenamine, 12 injections, total amount unknown. Mercuric chloride, 24 injections, total amount unknown.

PROGRESS.—September 10 and 30, 1929 blood Kahn reactions reported negative on January 1933, a routine examination of the cerebrospinal fluid was reported as follows: Cells 32, Kahn four plus, and "luetic" gold curve. The globulin test was not reported. Physical findings were negative. Patient has received tryparsamide, sodium iodobismuthite, and potassium iodide therapy with complete reversal of spinal fluid findings.

COMMENT.—Inadequate early treatment including *first examination of spinal fluid made over 6 years after first antisyphilitic treatment.*

Case 4.—E. E. R., white, male, born October 1904. Seronegative primary syphilis in January 20, 1927. He was given the following treatment:

January to March 1927.—Arsenical, 8 injections, type and total amount unknown. Potassium iodide orally, and mercurial rubs, amount unknown.

July 1927.—Kahn reaction negative.

September to December 1928.—Arsenical, 8 injections, type and total amount unknown. Mercurial rubs (35).

PROGRESS.—January 10, 1930, there appeared on the prepuce an ulcer, darkfield examinations of which were negative. January 23, 1930, there was a secondary rash, generalized adenopathy and the blood Kahn reaction was four plus. The following treatment was administered:

January to September 1930.—Neoarsphenamine, 27 injections, total amount unknown.

June 1930.—Kahn reaction four plus.

December 12, 1930 to January 15, 1931.—Neoarsphenamine, 5 injections, total amount unknown.

April to November 1931.—Neoarsphenamine, 18 injections, total 8.85 grams.

February 1932.—Kahn reaction four plus.

February to April 1932.—Neoarsphenamine, 8 injections, total amount unknown. Bismuth salicylate, 12 injections, total amount unknown.

August 1932.—Kahn reaction negative.

August 1932 to June 1933.—Neoarsphenamine, 8 injections, total amount unknown. Bismuth salicylate, 12 injections, total amount unknown.

February to November 1935.—Neoarsphenamine, 17 injections, total amount 8.7 grams. Bismuth salicylate, 8 injections, total amount unknown.

January 1936 to January 1937.—Neoarsphenamine, total 4.2 grams, number injections unknown. Bismuth salicylate, 17 injections, total 1.75 grams.

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The blood Kahn reaction was reported four plus on February 28, 1933, June 15, 1934, January 15, 1935, May 15, 1935, October 2, 1935, July 13, 1936, and November 2, 1936.

February 1937 a routine examination of the cerebrospinal fluid was reported as follows: Cells 5; Kahn four plus; globulin one plus; gold curve 5544321000. Physical examination was negative. There were no subjective symptoms.

COMMENT.—Seronegative primary syphilis in 1927, followed by reinfection or relapse in 1930. Original infection obviously undertreated including *first examination of spinal fluid was made 10 years after first antisyphilitic treatment.* Patient has received therapeutic malaria, and is undergoing tryparsamide therapy at present.

Case 5.—V. G. J., white, male, born November 1904. History of ulcer on penis with four plus Kahn reaction October 17, 1927. Diagnosis of syphilis was established and the following treatment was administered:

October 1927 to October 1928.—Arsenical, 38 injections, total amount unknown. Mercury salt, 32 injections, type and total amount unknown.

October 1928.—Kahn reaction negative.

January 1929.—Kahn reaction four plus.

September to October 14, 1929.—Mercuric succinimid, 12 injections, total 0.11 grams.

October 17, 1929.—Kahn reaction negative.

January 1930.—Kahn reaction three plus.

February 1930 to February 1931.—Arsenical, 11 injections, total amount unknown. Bismuth salt, 12 injections, type and total amount unknown.

PROGRESS.—January 1931 the blood Kahn reaction was reported four plus, and a routine examination of the cerebrospinal fluid was reported as follows: Kahn four plus. The health record did not contain a report of the cell count, globulin test, or colloidal gold curve.

There were no subjective or objective signs. Between 1931 and 1937 patient received therapeutic malaria, much tryparsamide intravenously, and much of several bismuth compounds intramuscularly. The spinal fluid findings have continued strongly positive, although the blood Kahn reaction has been negative for the past 2 years.

COMMENT: Seropositive primary syphilis with inadequate early treatment, relapsing type of serum reactions, and positive spinal fluid findings on examination *first made 4 years after first antisyphilitic treatment.*

Case 6.—W. B. G., white, male, born March 1909. No history of primary lesion. Developed secondary rash on August 7, 1930, at which time the blood Kahn reaction was reported to be four plus. The following treatment was given:

August to September 1930.—Arsenical, 8 injections, type and total amount unknown. Mercurial inunctions, total number 48.

November 1930 to February 1931.—Arsenical, 8 injections, type and total amount unknown.

PROGRESS.—In March 1931 the blood Kahn reaction was reported to be negative. Following the appearance of unexplained headaches, examination of the cerebrospinal fluid was performed April 1931 and reported as follows: Cells 148, Kahn three plus, globulin one plus, and gold curve 0245543332. He was given tryparsamide and bismuth therapy with relief from headaches and complete reversal of spinal fluid findings.

COMMENT.—Secondary syphilis with less than adequate treatment during first 6 months and *spinal fluid examined first time approximately 8 months after first antisyphilitic treatment.* This is of special interest since it is the only instance in this series of eight cases of neurosyphilis wherein a diagnostic spinal puncture was made during the first year of treatment.

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Case 7.—W. G. P., white, male, born June 1913. History of "open indurated lesion on penis" February 1933. No record of dark-field examination. The blood Kahn reaction was reported to be four plus in March 1933.

The following treatment was administered:

March to June 1933.—Arsenical, 10 injections, total amount 4.53 grams, type unknown. Bismuth salt, 7 injections, type and total amount unknown.

June 1933.—Kahn reaction negative.

June to September 1933.—Arsenical, 10 injections, total amount 4.08 grams, type unknown. Bismuth salt, 8 injections, type and total amount unknown.

December 1933 to February 1934.—Arsenical, 8 injections, type and total amount unknown. Bismuth salt, 5 injections, type and total amount unknown.

PROGRESS.—Blood Kahn reactions reported negative September 1934, June 1935, and May 1936. A routine examination of the cerebrospinal fluid was made March 1937, and was reported as follows: Cells 12, Kahn reaction four plus, globulin slightly increased, and gold curve 2344321000. There were no subjective or objective signs of neurosyphilis.

COMMENT.—This case is another example of inadequately treated early syphilis, with neglected examination of the spinal fluid. *The first diagnostic spinal puncture was performed 4 years after the first antisyphilitic treatment.*

Case 8.—R. L. P., white, male, born May 1901. No history of primary or secondary syphilis, although he was treated for chancroid, penis, in 1923. In February 1936, patient became disorientated, and showed depressive personality changes. Physical signs of dementia paralytica were present.

February 29, 1936, the blood Kahn reaction was negative. March 2, 1936, examination of the cerebrospinal fluid was reported as follows: Cells 26, Kahn reaction four plus, Wassermann reaction four plus, Pandy test two plus, and gold curve 2233321000.

COMMENT.—This patient received neoarsphenamine and bismuth therapy with much improvement in the spinal fluid findings, but did not show sufficient improvement in his mental symptoms to warrant return to regular duty. This is the only case in the entire series of 140 cases of syphilis that did not have an original diagnosis of primary or secondary syphilis.

An analysis of the records of these 140 cases of syphilis, with regard to the interval between the first antisyphilitic treatment and the first diagnostic spinal puncture reveals that in only 19 cases (13.57 percent) was an examination of the spinal fluid made during the first year of treatment. See table 1.

TABLE 1

Time interval and serological reactions

Serology	Time interval in years																	Total
	0-½	½-1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Positive	1	1	0	0	2	0	0	1	0	0	1	1	1	0	0	0	0	8
Negative	8	9	17	14	13	12	9	7	11	5	9	8	1	0	4	2	3	132
Total	9	10	17	14	15	12	9	8	11	5	10	9	2	0	4	2	3	140

The Annual Reports of the Surgeon General, United States Navy, [12] indicate that during the period 1930 to 1936, there has been a

[12] Annual Reports of the Surgeon General, U. S. Navy, 1930 to 1936, U. S. Government Printing Office, Washington, D. C.

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gratifying decrease in the annual admission rate for syphilis, a marked increase in the total number of diagnostic spinal punctures, and a slight but definite decrease in the syphilitic census of the Navy and Marine Corps as is shown in table 2.

TABLE 2

Year	Original admissions for syphilis		Number diagnostic spinal punctures	Strength of Navy and Marine Corps on December 31	Syphilitic census of Navy and Marine Corps on December 31	
	Total	*Rate per 1,000*			*Total*	*Percent*
1930	2,940	25.03	106	[a] 117,453	[b]	[b]
1931	2,871	25.46	79	[a] 112,767	[b]	[b]
1932	3,062	27.66	131	[a] 110,717	[b]	[b]
1933	2,639	24.39	102	105,691	15,111	14.2
1934	2,252	20.59	249	111,840	15,039	13.4
1935	1,607	14.07	1,877	117,149	14,897	12.7
1936	1,377	11.07	2,961	126,583	14,427	11.4

[a] Average daily strength.
[b] Data not available.

SUMMARY

1. Routine spinal fluid examination is indispensable in the management of a case of syphilis in any stage. Indications as to time of examination in early and late syphilis have been reviewed.

2. One hundred and forty consecutive cases with a history of syphilis, with at least one spinal fluid examination, were observed by the writer. In 8 cases (5.71 percent) the spinal fluid findings were abnormal, while in 132 cases (94.29 percent) the spinal fluid was normal.

3. Seven cases with abnormal spinal fluid gave a uniform history of inadequate early treatment, and with one exception the first examination of the spinal fluid had been performed 4 or more years after the first antisyphilitic treatment. There was one case of dementia paralytica in this series that had no previous diagnosis of syphilis.

4. Despite the widely publicized need of early spinal fluid examination in syphilis, only 9 (6.42 percent) of this series received this examination during the first 6 months of treatment, while 19 (13.57 percent) received a spinal puncture during the first year.

SYPHILITIC DATA RECORD FORM

By Lieutenant Milton R. Wirthlin, Medical Corps, United States Navy

The need for a uniform data record in venereal-disease treatment throughout the service is evident since numerous different forms are in use by medical officers treating these cases.

Eighteen months duty aboard a naval transport provided an opportunity to review hundreds of health records and numerous syphilitic data record forms received from all types of ships and

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stations. The principal objections to most data forms reviewed were: (1) Difficulty in filing due to size and type of paper used, (2) insufficient information of previous treatment and laboratory data, (3) too elaborate, retarding interpretation, (4) no space allotted for recording concurrent laboratory data, and (5) attempts at standardization of treatment, using one method for all types and stages of the infection.

The data record illustrated in charts 1 and 2 is printed on cardboard of health record size, making handling easy and filing with health record possible. The card gives sufficient data of previous history and treatment in a concise form for instantaneous summarization. The form is explanatory, yet not elaborate. Sufficient space is allotted for recording concurrent laboratory examinations. It does not attempt to standardize or influence the method of treatment. It is universally adaptable to either new or old syphilitic infections with any of the present methods of antiluetic treatment, such as simultaneous-continuous, simultaneous-intermittent, alternating-continuous, continuous-overlapping, intermittent, etc.

The front of the record is used for previous clinical data and treatment, thus giving at a glance all essentials, except present physical findings, for a basis to outline further treatment. Having arrived at some plan for further treatment it should be entered in columns 1, 3, 4, and 5, on the reverse side of the form. As the patient receives each weekly treatment, columns 2, 6, and 7 are completed.

Should the patient or medical officer be transferred prior to completion of the outlined treatment, subsequent medical officers can readily perceive the treatment plan. With such a record form it is feasible to refer a luetic to a syphilologist for a suggested outline of treatment. Thus a specific method of treatment for each type or stage of infection could be instituted and valuable statistical data gained from the results.

EDITORIAL COMMENT

The Bureau of Medicine and Surgery appreciates the necessity of keeping records and reports as few in number and as simple in form as service conditions permit. It does not approve the general use of unofficial forms due to the resulting confusion of records and the incidental increased printing costs.

Publicity is given to this particular unofficial data form because the need for some such record is recognized. The illustrated form is an excellent attempt to meet this need and its utility has been demonstrated by the author. However, certain imperfections are evident and publication is for the purpose of stimulating constructive criticism which is solicited by this Bureau. This form is proposed for local use only and is not suggested as a substitute for the present syphilitic abstract in the health record.

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CHART 1

Name Rate

Diagnostic Evidence

Date	Evidence
	Exposed at: (city)
	Primary on (state exact site)
	Dark Field for Treponema Pallidium
	Blood Reaction (state test)
	Secondaries
	Tertiaries

Clinical Data

Reactions											
Other Treatment											
Heavy Metals	Tot. gms.										
	No. Injs.										
	Drug										
Arsenicals	Tot. gms.										
	No. Injs.										
	Drug										
To											
From											

Serological Data

Date	Test	Reactions

Spinal Fluid

Date

Cell Count

Kahn or Wass.

Globulin

Lange

126225—39——4

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CHART 2

OUTLINE OF ANTILUETIC TREATMENT

Week of Treatment	Date Treatment Given	Arsenicals in Grams	Heavy Metals in Grams	Other and Non-specific Treat.	Albuminuria in Plus Signs	Blood Kahns, Spinal Fluid, Reactions Initials of Med. Off. giving Treatment
1						
2						
3						
4						
5						
6						
7						
8						
9						
10		Drug		Drug		Kahn
11						
12						
13						
14						
15						
16						
17						
18						
19			Drug			
20						Kahn
21						
22						
23						
24						
25						
26						
27						
28						
29		Drug		Drug		
30						Kahn
31						
32						
33						
34						
35						
36						
37						
38			Drug			
39						
40						Kahn
41						
42						
43						
44						
45						
46						
47						
48						
49		Drug		Drug		
50						Kahn
51						
52						

SPLENECTOMY FOR GASTRIC HEMORRHAGE

IN SPLENOMEGALY ASSOCIATED WITH SYPHILIS. CASE REPORTS [1]

By Lieutenant Guy E. Stahr, Medical Corps, United States Navy

Surgical removal of the spleen as a primary therapeutic measure dates back some 40 years in its inception. The great bulk of success in its application has been in the past 15 years with the advance in our knowledge of splenic functional disturbances more clearly indicating the rational of such procedure.

[1] From the Surgical Service, U. S. Naval Hospital, San Diego, Calif.

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The spleen is still an organ of mystery. Its apparent functions are only in the realm of probability, and its removal causes no permanent effects other than the relief of symptoms of its own probable disfunction. Generally, the symptoms of splenomegaly may be ascribed to the mechanical effects of the enlargement. This may be true in the relatively uncommon gastric hemorrhages of splenic origin such as in splenic anemia, Banti's disease, and unclassified splenomegaly with gastric hemorrhage, leading another step toward the thought that a l may have a common etiology. The mechanism of gastric hemorrhage of splenic origin, in most cases, has been attributed to rupture of gastric or esophageal varices formed as a mechanical result of, or concomitant with, the splenomegaly. The theories of the formation of the varices in the stomach and lower esophagus are: (1) venous back-pressure in the splenic vein due to its sclerosis and thrombosis, and (2) dilatation of the gastric veins to accommodate the increased arterial supply of blood through the gastric branches of the splenic artery.

There are many cases of gastric hemorrhage with splenomegaly in which the spleen does not show the fibrosis of trabeculae and reticulum which is a characteristic of splenic anemia. Other cases of gastric hemorrhage occur in splenomegaly of congestive type where there is sclerosis or phlebitis of the splenic and portal veins. It has been known for years that syphilis is frequently associated with an anemia of increased blood destruction accompanied by splenomegaly and may be responsible for splenic alteration which exactly simulates a syndrome of unknown etiology. The distinction between syphilis of the spleen and splenic anemia of syphilitic origin may be poorly defined. Clinically, a differentiation from splenic anemia is nearly always impossible, and pathologically, it is frequently so. In the spleen, more than in any other organ, the pathologist is forced to relegate morphology to secondary importance and to rely largely on all other information to arrive at a proper diagnosis. The entire problem of splenic anemia, Banti's disease, thrombosis of the splenic vein, and unclassified splenomegaly of infectious origin with gastric hemorrhage leads to suspicion of a common etiology.

The cases reported here would appear to belong in a catagorical grouping of unclassified splenomegaly with gastric hemorrhage, probably of infectious origin and the following factors were present in each case:

(1) Abrupt onset of a painless hematemesis.

(2) A secondary anemia out of proportion to or of greater degree than could be accounted for by the hemorrhagic blood loss.

(3) The enlargement of the spleen while very definite, did not attain the size attributed usually to that found in the primary splenic disorders.

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(4) Syphilis: Cases 1 and 3 were of long standing and case 2 while of shorter duration was apparently latent despite negative serology.

(5) Symptoms recurred in a variable period of time following an apparent recovery from the initial attack.

CASE REPORTS

Case I.—H. V. W., C. Ph. M., admitted February 15, 1938.

CHIEF COMPLAINT.—Hematemesis, melena, weakness.

PAST HISTORY.—Usual childhood diseases. Herniorrhaphy, left, 1919; sciatica, left, 1929. Syphilis contracted 1924 and actively and energetically treated for 13 years. Blood Kahn and Wassermans persistently positive except for brief negative period occurring in 1928.

PRESENT ILLNESS.—In August 1937 had onset of frequent black and tarry stools, followed by repeated and copious hematemesis, marked weakness and faintness. For several weeks preceding onset, had been receiving antiluetic treatment of intravenous neoarsphenamine in weekly doses. The blood Kahn was 4 plus and the spleen was palpably enlarged. A severe anemia was present as low as 1,500,000 with hemoglobin 20 percent. Treatment by repeated blood transfusions and liver and iron therapy over a period of 3 months was successful in returning patient to a feeling of well being and clearing up the anemia. It was felt, with a persistently enlarged spleen and long standing syphilis, that a condition of syphilitic splenitis existed which was the underlying cause of the hemorrhage and anemia. Splenectomy was considered at the time but with the marked improvement in condition was postponed until considered more practicable and patient was returned to duty on November 24, 1937. After a period of 10 weeks of apparent well being, there was a rapid onset of weakness, faintness, frequent tarry stools, nausea, and hematemesis. Patient was readmitted to hospital on February 15, 1938.

PHYSICAL EXAMINATION.—Age 37, weight approximately 135 pounds, height 67 inches, fairly well developed and nourished, acutely ill in appearance and markedly anemic. Skin, sclerae, mucous membranes pale.

Systolic murmur over precordia not transmitted. Pulse very shallow and rapid. Blood pressure 116/0. Abdomen soft and rounded, spleen barely palpable. Findings negative otherwise.

LABORATORY FINDINGS.—RBC, 1,160,000; Hgb, 40 percent, blood Kahn 4 plus.

TREATMENT.—Blood transfusion of 500 cc., indirect method, was given immediately and repeated on February 16 and February 19. Considerable improvement resulted. February 23 RBC, 3,000,000; Hgb, 58 percent.

OPERATION.—On February 24 splenectomy was done. The spleen was enlarged and inflamed, and enlarged glands were found in the pedicle. Constricting bands were found about the duodenum. No evidence of ulcer duodenum or stomach, or enlargement of liver was noted.

HISTOPATHOLOGICAL REPORT.—Specimen consists of a spleen weighing 450 grams. The enlargement is symmetrical. There is moderate thickening of the capsule. No change in consistency noted on sectioning. Microscopic sections show the principal alteration to be increased fibrosis throughout the pulp. The sinuses apparently are not encroached upon by the thickening of the cords and are prominent in all areas. Lymph follicles are present although rather small in size. Lymphocytes are present throughout the pulp in varying numbers. The capsule and its trabecular projections are not thickened and the sheathed vessels are normal in appearance. The microscopic appearance is consistent with that of either Banti's disease or chronic luetic fibrosis.

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POSTOPERATIVE COURSE.—Recovery following operation was uneventful, and dietary with liver extract was instituted. The weakness, faintness and anemia had a gradual improvement over a 4-week period; the RBC arose to 4,100,000 with Hgb, 95 percent. No nausea, hematemesis, or blood in the stools have been present. On March 12 antiluetic treatment, using Mapharsen, was begun and has progressed normally.

April 11, 1938 Kahn report 2 plus. The patient is entirely symptom free and states he feels as well as at any time during the past few years.

Case 2.—J. F. L., Sea. 1c., admitted July 19, 1937.

CHIEF COMPLAINT.—Vomiting of blood.

PAST HISTORY.—Usual childhood diseases, good recovery. Diphtheria at age 12 with no complications. Syphilis 1932 with intensive, active treatment, followed by negative serology after 1 year.

PRESENT ILLNESS.—In October 1936 had hematemesis and diarrhoea lasting several days, with marked weakness and severe anemia accompanying. Was given repeated blood transfusions, thromboplastin and intravenous calcium. X-ray showed suggestive old duodenal ulcer and an enlarged spleen. Under Sippy regime, anemia slowly cleared up along with other symptoms and signs. Splenomegaly was noted physically as being nontender, and the size diminished as signs and symptoms cleared up. A diagnosis of ulcer duodenum was made on the suggestive x-ray findings, despite the typical gastro-intestinal hemorrhages, anemia, weakness, and splenic enlargement. Patient returned to duty after 152 sick days free of symptoms and signs except for some continued increase in size of spleen. Readmitted July 19, 1937 following a sudden onset of bright red hematemesis which followed dietary and alcoholic indiscretions of previous night. Slight feeling of weakness only accompanying symptom.

PHYSICAL EXAMINATION.—White male, age 26, lying comfortably in bed and not apparently ill. Mucous membranes and skin somewhat pale. A systolic blowing murmur was noted over aortic area but not transmitted. The pulse was accelerated to 120 but was of fair volume. Abdomen was normal except for a nontender, palpably enlarged spleen.

LABORATORY FINDINGS AND CLINICAL COURSE.—RBC, 3,640,000; Hgb, 76 percent, on admission.

On July 20 there was spontaneous hematemesis of 5½ cupfuls of fresh blood without pain or distress; RBC, 2,000,000; Hgb, too low for reading. A transfusion of 500 cc. whole blood was given.

On July 25 following a gradual rise in RBC to 3,000,000, Hgb, 63 percent, patient was started on Sippy dietary. No recurrence of hematemesis had taken place. Patient remained comfortable throughout although considerably weakened, and on July 28 following tarry stools the RBC dropped to 2,600,000 with Hgb, 56 percent. Concentrated liver extract was then used intramuscularly and orally. Little change in anemia and weakness resulted and on August 7 the RBC was 2,600,000 with Hgb, 56 percent and the splenomegaly had increased considerably. No subjective complaints were present.

On September 14 the RBC was 4,160,000, Hgb, 93 percent. The splenomegaly remained the same. G. I., x-ray series negative for ulcer. Spinal fluid showed slight Pandy reaction, 14 cells per cubic millimeter with normal colloidal gold curve. Blood Kahn was negative. Patient subjectively felt well.

In view of recurring gastric hemorrhages, anemia, and marked splenomegaly with history of syphilis in the absence of signs of Banti's syndrome, and the ruling out of duodenal or gastric ulcer, it was felt that a splenic syndrome of infectious origin must be causative.

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OPERATION.—Splenectomy was performed on October 5. The spleen was enlarged and showed evidence of inflammation with enlarged nodes in the hilum. Stomach, duodenum, and liver were normal.

HISTOPATHOLOGICAL REPORT.—Histopathologic sections of the spleen showed a generalized increase of the fibrous tissue framework and a dilatation of the sinuses. Hemosiderin was universally present as small flecks, both extra and intracellular, in the fibrous tissue as well as the phagocytic cells. Lymphoid tissue was diminished in amount. The larger intrinsic vessels were all thickened although there was absence of any increased thickening of the trabeculae. In a few isolated areas clear hyaline bodies resembling hyaline casts or single segments of bamboo cane were present and faintly impregnated with hemosiderin, the process resembling an early Banti's disease.

POSTOPERATIVE COURSE.—Recovery from operation was uneventful. The RBC returned to 4,600,000 with Hgb, 95 percent and all signs and symptoms subsided. Patient discharged to duty on November 12, 1937, and to date, 6 months after splenectomy, has remained totally free symptomatically.

Case 3.—W. A. D., C. E. M., (F. N. R.), admitted July 29, 1933.[4]

CHIEF COMPLAINT.—Nausea and hematemesis.

PAST HISTORY.—No unusual illnesses in childhood. Enlisted in Navy 1907 and served continuously until 1922. Married 1925, and wife died 1932 of pulmonary tuberculosis, having no children. Patient had gonorrhea 1908, denies and has no history of penile lesion although gives history of a dermatitis in 1906 for which he was treated with salvarsan.

PRESENT ILLNESS.—Gradual onset of epigastric distress after meals beginning January 1933. This distress was soon accompanied by vertigo, nausea, and hematemesis. Kahn blood test found to be 4 plus and spinal fluid Kahn negative. The stools were very dark and on examination showed presence of occult blood. X-ray examination showed normal lung fields.

A considerable anemia being present, a series of blood transfusions were given, followed by exploratory laparotomy on April 28, 1933. At operation no pathology of the gastro-intestinal tract could be found to account for the gastric hemorrhage. A considerable amount of ascitic fluid was present and the spleen was found moderately enlarged. The liver was apparently normal. It was assumed that the splenomegaly was due to syphilis and that antiluetic treatment would be the treatment of choice prior to radical treatment of splenectomy, hence the abdomen was closed without further operative procedures.

Following the exploratory operation it was necessary to do abdominal paracentesis on three different occasions removing from 3,500 to 4,200 cc. of fluid from March 15 to 31, 1933. The anemia cleared up gradually and symptoms slowly abated; RBC arose to 4,500,000 with Hgb, 65 percent; WBC, 6,450; lymphs, 32 percent; and polys, 68 percent. Patient was started on intensive antiluetic treatment and discharged to outpatient service on June 23. After 5 weeks, he had sudden onset of vomiting of large amount of bright red blood and was readmitted to the hospital on July 29, 1933.

PHYSICAL EXAMINATION.—Age 43, semiconscious condition, appearing exsanguinated. Skin and mucous membranes pale. Abdomen moderately distended, with a firm, nontender, and considerably enlarged spleen palpable. Findings negative otherwise.

LABORATORY FINDINGS AND CLINICAL COURSE.—An immediate blood transfusion of 500 cc. by indirect method was given. July 31, RBC, 1,330,000; Hgb, 10 percent; transfusion of 500 cc. blood was given. August 1, RBC, 2,050,000; Hgb, 38 percent; transfusion of 500 cc. blood was given; WBC 6,000; segments 74;

[4] Reported in U. S. Nav. Med. Bull. 33: 261-263, 1935.

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bands 3; juveniles 1; monos 3; lymphs 19. August 11 the fourth blood transfusion of 500 cc. was given; RBC, 2,070,000; Hgb, 29 percent.

OPERATION.—Operation was performed on this date and splenectomy was done. As at the previous exploratory operation, the liver appeared to be normal and no pathology of the gastro-intestinal tract was found.

HISTOPATHOLOGICAL REPORT.—Specimen consists of an enlarged spleen measuring 16 by 9 by 9 cm. The organ is slate colored, capsule is thickened and wrinkled, suggesting a recent loss of substance with corresponding lessening of tension upon the enveloping fibrous capsule. On cut section, the color is beefy red and the consistency firm. Microscopic section shows the capsule to be thickened to such extent that the normal architecture is obscured. There is slight increase in the number of sinuses, and the individual sinuses are dilated and for the most part are empty. This fact suggests an organ that was congested and partially explains the wrinkling of the capsule. A moderate amount of infiltration of the reticulum by red blood cells and a few leukocytes is present. A few isolated collections of lymphoid tissue are scattered throughout the section. No evidence of perivascular infiltration is noted.

POSTOPERATIVE COURSE.—Following operation, dietary treatment of anemia was instituted, and there was a gradual improvement in the blood picture over an 8-week period accompanied by subsidence of symptoms. Active antiluetic treatment was continued as soon as condition of patient warranted its use. At discharge on October 16, 1933, the anemia was almost entirely cleared, the RBC being 4,200,000; Hgb, 85 percent. The blood Kahn persisted as 4 plus. A report of the patient 1 year after splenectomy was of good health, freedom of symptoms, but continued 4 plus serology despite active antiluetic treatment.

CONCLUSIONS

From the data of these three cases of gastric hemorrhage with splenomegaly and associated syphilis, it appears that splenectomy is the treatment of choice. Such cases seem to belong in a group as, unclassified splenomegaly of infectious origin with gastric hemorrhage and anemia, as differentiated from the splenic anemia syndrome, the diagnosis of which rests on the absence of any known etiology.

The presence of syphilis clinically in these cases as latent, treated and untreated, with the inability of pathologists to definitely diagnose splenic anemia of syphilitic origin differentially from splenic anemia and Banti's disease of an unknown etiology, suggests a common etiology.

Antisyphilitic treatment appears to have had little bearing upon development of the conditions in these cases. Two cases had received ordinarily adequate and intensive treatment over a considerable period of time while the other case, never treated prior to onset of symptoms, showed no response to its use in the free interval between initial onset and recurrence. Since each of these cases had a severe recurrence of hemorrhage and anemia after an interval of apparent recovery following conservative treatment, it is apparent that the earlier splenectomy can be accomplished the less the opportunity for a recurrence which could readily prove fatal.

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The cases herein described have shown one each in the second, third and fourth decades of life indicating that age in onset of such syndromes is likely to be no significant factor in their development.

As the operative results in these cases were entirely successful, contrary to the prevalent view of the hazardous nature of splenectomy, this would compare more than favorably with the results of other major abdominal operations.

THE UTILIZATION OF PSYCHIATRY IN THE ARMED FORCES [1]

By Assistant Surgeon General Dallas G. Sutton, United States Navy

A review of the development of the medical departments of the Army and Navy thus far in the twentieth century shows much progress coincident with the advances made in the medical sciences. These departments were established on the basis of frank necessity. Those injured in battle ashore or afloat required medical treatment. Hygiene was then but beginning its remarkable development and camp and ship hygiene was anything but a science. Medical personnel was inadequate in number, in training, and in organization of responsibilities and techniques. Medical equipment was sparse, unstandardized, and often inaccessible. Supplies were meager. The physical examination of recruits for gross defects and disabilities did not always happen, and there was nothing like an attempt at their physical and mental evaluation.

The basic function of these departments is still the treatment of injuries, disabilities, and diseases of combat troops, but the scope of this function is vastly expanded in many constructive directions. The waging of defensive or offensive war has come to involve the utilization of most of the great advances in science and technology. Its stresses on combat personnel are tremendous. The range and destructive ability of guns is greatly increased. Intricate apparatus in great quantity and variety are involved in fire control, antiaircraft and antisubmarine measures, in air warfare, and in fleet and field communications. The machinery of modern warfare requires highly skilled personnel for operation and for maintenance. The whole intricate pattern of warfare and of the preparedness that avoids war or reduces its disastrous results rests finally on effective personnel. The medical departments have had, therefore, to progress hand in hand with the combat forces, into an ever broadening field of responsibility. It is most fortunate in this connection that the medical profession has kept fair pace with the growth of natural science and technology. Modern preventive medicine, the more general use of biologicals for prevention and treatment of communicable diseases,

[1] Submitted concurrently for publication in Psychiatry, Journal of the Biology and the Pathology of Interpersonal Relations, 1835 Eye Street NW., Washington, D. C.

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and the perfection of essential surgical procedures are some of the outstanding achievements in a progression that includes increasing understanding of many important problems.

The military surgeon of today is engaged in many activities that have a direct bearing on the competency of his immediate organization. This fact may be more fully appreciated when it is realized that a major unit of the fleet, a battleship, might be rendered ineffective by an ill-advised decision on the part of the medical officer of the ship relative to the handling of an epidemic involving some of the crew. By the same token a decision to continue on duty in a key position an officer who is showing signs of instability may have considerable bearing on the battle efficiency of the ship. These and many matters of equal importance indicate the necessity for demanding a high professional standard. This standard can only be maintained by rigid selection of candidates presenting themselves for entrance into the corps. Once in the service the physician is afforded the opportunity to establish a firm foundation for his career through training and study that should prepare him to meet the special problems that are peculiar to the combatant forces.

While many noteworthy steps in the progress of both internal medicine and surgery had been experienced before 1900 psychiatry had remained in the doldrums until the treatise of Emile Kraepelin, of Munich, was fully evaluated by the profession. His new classification appeared to open new avenues of interest in psychiatry, research into obscure psychotic manifestations was stimulated, descriptive psychiatry was developed to a remarkable degree and as a result of the general enthusiasm a more constructive attitude toward the psychotic patient came into being. Prior to this time hospital authorities apparently were content to afford merely an asylum for the unfortunate individual exhibiting an abnormality that necessitated his removal from the community. Upon admission of the patient he was classified mainly on the basis of his conduct, little or no treatment was offered unless an acute physical illness intervened, there was little hope of material improvement or recovery, and it was ordinarily assumed that the hospitalization would result in permanent invalidism. This defeatist attitude seems chiefly to have been the result of disappointment from poorly timed efforts. The evaluation of early treatment had not been made. Most patients were sent to the hospital only after they were well-advanced in their illness, when the psychotic process had progressed beyond the point where constructive assistance is of principal value. The hospital psychiatrist, not knowing what could be done in the acute stage of these disorders, had no incentive to apply himself to the occasional early case that he saw. Other elements that unquestionably influenced the development of a complaisant attitude toward the mentally ill were the family taboo with the resultant public

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reaction and finally the archaic commitment procedure that was almost universally required in those days. Fortunately, these factors have been changed or to some extent neutralized so that they no longer influence the situation so unfavorably.

Modern psychiatry had its inception in the hospital where physicians began the attempt to evaluate reactions and to study other material that was at hand. Prior to the advent of modern psychiatric thought, the etiology of the so-called functional abnormality was shrouded in mystery. In those illnesses that could not be attributed to heredity, or some recognizable physical condition, there was no appreciation of the fact that the condition might be due to personal maladjustment. The interplay between the individual and his environment received no serious attention from the physician, and, in fact, there was no means of evaluating such conditions at that time. Investigation into the status of the neuroses by Janet, Prince, Freud, Meyer, White, Jelliffe, and others, begun in the latter part of the nineteenth century, has resulted in the clarification of that problem. The information deduced from these studies has led directly to preventive measures that are being used today by physicians in the treatment of this relatively benign illness that might otherwise develop into a more serious condition having psychotic manifestations. In his work on juvenile delinquency, Healey [2] applied the principle of preventive medicine in connection with his work in mental hygiene.

During the period of the World War a great deal of interest was stimulated in the utility of psychiatry in dealing with many problems. Within the armed forces it was demonstrated that intelligent handling of psychiatric problems had an important bearing on both efficiency and morale. In the Army psychiatrists were mobilized from the staffs of mental hospitals throughout the country and these physicians, after being commissioned in the Medical Corps, were afforded a period of indoctrination and training prior to being assigned to duty. Most of these physicians, as I recall it, in the beginning at least, were under the supervision and training of Dr. William A. White, who was at that time the superintendent of St. Elizabeths Hospital. Later on as the disastrous ramifications of modern warfare became evident, additional psychiatrists were called to the Colors, and related personnel was pressed into service as psychologists, personnel managers, "morale officers," sociologists, etc. During the continuation of the war psychiatric specialists accomplished a great deal, but many phases of the general problem were left untouched. However, the value and utility of the undertakings were recognized and it is anticipated that the scope of psychiatric endeavor will be materially extended in the event of another national emergency.

[2] Healey, William, Scientific Study of Delinquents. N. Y. State J. Med. 19:79-85. (1919).

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This new appreciation of psychiatry that was developed in the Services during the continuation of the crisis appeared to stimulate general interest in the specialty in civilian communities as well. Physicians returning to their practices on demobilization carried with them new objectives based on their experiences in the American Expeditionary Force, and grateful patients did not hesitate to relate their impressions of psychiatric accomplishments in their immediate organizations. Individuals in the Service appreciated the fact that the intelligent handling of neuroses had resulted in a higher percentage of recoveries than had formerly been experienced.

During the early part of the war, when war neuroses were merely classified and returned home for hospitalization, with little hope of immediate improvement, the effect on morale was not constructive, but later when this type of illness was treated in the immediate war zone a much higher percentage of recovery was experienced and the improvement in morale, as a result, was evident. This step forward in the procedure looking to the hospitalization of psychiatric patients and the adoption of the more modern psychiatric concepts, with relation to the treatment of the war neuroses and allied conditions, may be attributed to the foresight, intelligence, and general administrative ability of Col. Thomas W. Salmon, Medical Corps, U. S. Army, and his associates.

To those men who have been in touch with psychiatric development over a relatively extended period, there is a definite realization that the crisis afforded a stimulus and drive that have carried through to the present day. Much of the success of this period can safely be attributed to the coordination of interest and administration that was accomplished. However, the contributions made by outstanding psychiatrists, such as Colonel Salmon and the late Dr. William Alanson White, had more than a constructive bearing. Today within the profession there is more general appreciation of the value of psychiatry and the public has become more conscious of its utility and actual value. Internists recognize the value of psychiatric training and the layman has learned to seek the advice of the psychiatrist in attempting to formulate means of intelligently handling personality problems.

In spite of the stimulation that the specialty has received in recent years, it is doubtful if American psychiatry has actually met the challenge of its opportunities. In the words of Ross Chapman,[3] speaking before the American Psychiatric Association:

> One returns to the realization that squarely on the shoulders of psychiatry falls the obligation of direction of varied and often divergent forces, the providing of essential public education and medical teaching and leadership—and the obvious dangers of continued failure to provide such leadership.

[3] Chapman, Ross McClure, Presidential Address, Amer. J. Psychiatry 95:1-14 (1938).

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So long as the specialty recognizes what its actual objective should be, there should be little or no hesitancy in taking the proper steps toward realization.

The more enlightened psychiatry is destined to be of as much assistance to the general public as it is to administrators of psychiatric institutions and individual patients. Its influence was soon felt in the general field where its principles were utilized to assist in the solution of problems involving public relations. Within the field of preventive medicine, where it was found that the successful application of important hygienic measures could not be made because of misunderstanding on the part of the public or in those instances where preventive measures had been planned on the basis of an inadequate knowledge of mass psychology, the application of modern psychiatric principles was found to be of material help. Resistance based on environmental influences and other factors resulting in prejudice can ordinarily be overcome only by exposure to reason and understanding. It is in relation to the consideration of such problems, and other equally important matters, that psychiatric concepts may still further be advantageously employed.

Since psychiatry is a specialty that affords the basis for intelligent evaluation of individual reactions to all types of stimulation, its range of usefulness is practically without limit. Psychiatry now affords a rational basis for the interpretation of fact, the motivation of behavior, the development of reason, and other processes which have a bearing on human interaction generally. The constructive use of these newer concepts has resulted in understanding that has been beneficial to individuals and to groups.

The writer is of the opinion that the combatant services are more conversant with psychiatric principles and their objectives than is the public at large, but the field for accomplishment is none the less broad. The medical authorities of the armed forces, visualizing the needs of their organizations, and planning for intelligent accomplishment within the ever present budgetary limitations, have appreciated the fact that extensive utilization of modern psychiatry, in all of its phases of application, is desirable. This fact was demonstrated as far back as 1909 when the Surgeons General of both Services accepted the invitation of the Superintendent of St. Elizabeths Hospital, then the Government Hospital for the Insane, to assign medical officers to that institution for instruction and study. At the time Dr. William A. White directed the attention of the authorities to the broadening field of psychiatry and he stated that in his opinion a survey of the clinical material in the hospital would unquestionably point to some means of lessening the incidence of mental disease in the armed forces. From this time on medical officers of the Army and Navy have been afforded postgraduate instruction in the specialty.

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As the years have gone by medical officers in considerable numbers have received this excellent basic training so that a small nucleus of psychiatrists is constantly available for both services. These physicians have been utilized in key positions where their special attainments have afforded the proper background for successful accomplishment. Should it be decided to extend psychiatric activities in keeping with the scope of such activities within the civilian population the present number of specialists available would be inadequate but the group would unquestionably serve as a valuable foundation on which a very acceptable organization could be built. This scheme of organization has been visualized with reference to anticipated expansion in the event of national emergency.

A general plan looking toward the extension of modern psychiatry in the Army and Navy, beyond the scope of its present application, would of necessity be predicated upon its recognized utility. In order that the general Service environment may be appreciated by those not familiar with such matters, it is felt that a brief discussion of certain pertinent facts may be of assistance. Every citizen is conversant with the fact that our combatant forces have for years been restricted to a size that was considered necessary to afford protection only to our shores and, since the Spanish War, to our possessions. With the exception of the period of the World War this policy has continued in effect until today when we are all witnesses of a modification of that policy that is being stimulated by an international situation that is becoming acute. If history is to be repeated we will revert to our former policy following the solution of the immediate problem. In any event, our armed forces are normally maintained as a skeleton organization sufficiently large to fulfill its peace-time mission, and having sufficient elasticity to afford rapid expansion in the event of a national emergency. On this basis our Army is small compared to that of any possible antagonist. For that reason its essential activities have been confined to the protection of key positions, the training of personnel with a view to developing competent leaders, and the organization of a national reserve.

The peace-time Navy functions similarly in principle but its size is relatively larger since its essential equipment, the highly mechanized ships, must be procured before and not after the development of a crisis. In this branch of the Service in which technicians are the keystone of each ship organization, the element of special training is time consuming. Competent personnel in ordnance, navigation, communications, submarines, etc., cannot be developed in a short period. The Navy in addition is required to police trade routes and establish and maintain bases far removed from the United States.

This statement of Service objectives serves to accentuate the important bearing that the individual has to the success of the whole

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organization. For this reason it would appear advisable to investigate each person presenting himself for entry into the Service with a view to evaluating his mental as well as his physical attainments. Actually such an effort is being made by the medical authorities to survey incoming personnel with a view to excluding all individuals giving any indication of being inacceptable from the standpoint of their mental reactions. Under normal conditions the field for activity of this type is restricted, but in time of war the possibilities of accomplishment are practically unlimited. Experience gained during the last major war has served to point toward many desirable objectives in the selection, training, and distribution of the large number of troops that are accumulated in a relatively short time.

Immediately after the declaration of war the armed forces will receive a large mass of individuals representing a typical cross section of American manhood. In this group, of course, will be found psychopaths, individuals exhibiting inherent inferiority, some having intellectual attainments that are below the accepted level, and others, that study will reveal to be potential or incipient psychotics. The writer's experience throughout a period of some years points to the fact that the psychopath has more difficulty in adjusting to the Service than has any other type of questionable individual. A recruit in this classification is not amenable to discipline and he ordinarily can not comfortably be assimilated in any part of the organization without having an influence on morale. The constitutionally inferior and the medium-grade intellectual types are ordinarily acceptable if properly classified and utilized in the proper locations within the organization. Those found to be potentially psychotic, of course, should be eliminated together with the individual who is found exhibiting prodromal symptoms.

Actually, under normal conditions, the loss of man days attributed to the study and hospitalization of these cases is very considerable. For this reason the Service authorities unquestionably will anticipate instituting a procedure that will include psychiatric investigation. It is anticipated that the detailed study of the recruit will be made in the Army at a cantonment or in the Navy at a training station. Ordinarily such units are located at convenient points throughout the country so that there will be a distribution of the personnel without undue crowding. Anticipating that this plan probably will be followed in the next national emergency, it is assumed that groups of psychiatric specialists will be located at each of the places mentioned with a view to eliminating, as rapidly as may be possible, individuals found to be unsuited for one reason or another. Continued studies, looking toward the elimination of the individuals that harbor borderline indications of inacceptability, will be continued throughout the preliminary period of indoctrination.

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At this time more thorough and detailed studies very probably will be made to determine an individual's vocational aptitude. Both the Army and Navy of necessity include many vocational specialties, such as aviation, radio, the mechanical trades, ordnance, etc. In connection with the selection of individuals for these various specialties, it is necessary to consider psychological elements as well as education, training, and personality trends. In the early days of the Service, when the organization was relatively small, an individual was merely instructed to prepare himself for a special job, but now great care is taken in the element of selection and the trend toward a more intelligent handling of this problem has resulted in a very marked increase in efficiency. During the World War psychologists and psychiatrists did very valuable work in connection with the training and selection of personnel, but it is anticipated that still more satisfactory results will be realized in the event of another major conflict.

In recent years personality studies have been conducted in connection with aviation personnel. These studies were originated with the idea of eliminating the frankly unfit from aviation before actual training had been begun. It was thought that if the poor material was eliminated at the beginning the Government might be saved a great deal of money and the percentage of crashes might also be very materially reduced. This psychological study, I am given to understand, has been conducted in both of the Armed Services, but up to this time the rejection of aviation personnel on the basis of personality reaction alone has not been recognized and adopted.

In times of peace it is felt apparently that elimination in a relatively small group should be made on the basis of actual trial and error, rather than on the basis of personal inaptitude. In national emergency, however, with the great amount of material that will be presented for aviation training, early elimination will of necessity be more or less mandatory and it is felt that a study of the material now being accumulated may point to the psychological method as being both acceptable and desirable. This fact is mentioned here merely as an illustration of the type of problem that may develop within the combatant forces should the country be confronted by a major war.

In addition to those phases of the problem already discussed there is one of major importance that should be given consideration. I refer to that of hospitalization. Today, under normal conditions, the hospitalization of mental patients is accomplished under very satisfactory conditions. In the Army these cases are studied as they arise at post and general hospitals with a view to affording the most modern treatment in the anticipation that a large percentage will recover or improve to a degree that they may be returned to their homes. Others, not amenable to treatment, and those giving evidence of the need of long hospitalization are ordinarily transferred to the

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psychopathic department of the Walter Reed Hospital in Washington for more detailed study and treatment. The Navy follows the same general type of plan except that its definitely psychotic group, consisting of those patients not responding to early treatment within a reasonable period, is transferred to St. Elizabeths Hospital in Washington. In the plans of both Services it is evident that institutionalization of mental patients is postponed until it is evident that such a step is frankly necessary. This general scheme has proved very satisfactory in all essential respects, but, of course, in the event of war a much greater number of patients would necessitate the establishment of mental hospitals in the field as well as at home.

A very hasty review of the points of psychiatric application within the Services, which have been previously enumerated, reveals the fact that a number of other psychiatric activities, recognized by the civil communities as being helpful and constructive, have not been included. There has been no organized attempt apparently to afford the personnel the type of advice and treatment that is made available to the general public through the medium of mental hygiene clinics. Individual medical officers in both Services, having an adequate background in psychiatric principles, have rendered advice and assistance of this type while engaged in their routine duties, but insofar as is known no attempt has been made specifically to establish such a service. Reticence on the part of the personnel to request this type of assistance, a lack of appreciation of its value, and the shortage of experienced psychiatrists in both Services are all factors that have had a bearing on the situation. However, as the two Services grow and the actual importance of mental hygiene is appreciated, this type of activity will unquestionably be given serious consideration.

Those understanding the psychology of the armed forces, and having some appreciation of psychiatric evaluations as well, fully appreciate the fact that the development of personality studies in connection with the selection and allocation of personnel should prove to be of great value. However, it is also realized that the personnel has not yet reached the stage of psychological enlightment that would allow it comfortably to be judged on the basis of personality trends. One has little difficulty in adjusting to a physical handicap that may be disqualifying because it carries with it no implication that is distasteful, but a mental handicap, in spite of the present day knowledge, is not comfortably accepted. Unfortunately, the information accumulated by the layman, through the reading of popular books on psychoanalysis and other psychiatric subjects, has not always led to understanding.

While this is unfortunate there is every reason to anticipate that intelligent handling of the subject will eventuate in constructive assistance to the many who are in need of it. Recent economic developments resulting in unemployment, the tendency toward the lowering

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of moral standards and the strife that has grown up between classes and races all tend to make personal adjustment more difficult. There appears to be no question as to the utility of psychiatry in connection with problems arising from conditions of this kind, but its unqualified acceptability is not generally acknowledged. However, this reaction is not so serious that it can not be overcome by well directed measures formulated to acquaint the public with the type of assistance that it might anticipate.

This rough survey of normal psychiatric objectives, within the Services, in times of peace, indicates that many of the modern principles utilized in civil communities are already in use in both the Army and Navy today. Other phases are being used to a limited extent and still others, having to do with interpersonal and public relations, are not being utilized mainly because the value of the procedure is not clearly understood.

Since the cardinal mission of the medical departments of the two Services is to maintain the health of each organization as well as to promote morale and to plan for increasing efficiency, it might be assumed that considerable effort is expended routinely in research and investigation. While this is true to a certain extent, the scope of such activity actually is limited, by available personnel and restricted appropriations, to a small percentage of those projects recognized as being of probable value. At this time, for instance, psychological studies are being made at the naval aviation training base in Pensacola, but in view of the limited personnel available for this work, progress is relatively slow. It should be quite evident that the Services are not only aware of the value of many modern psychiatric methods, but that they are attempting to utilize them constructively insofar as may be possible. Further application of the science, along more extended lines, will eventuate as its utility is demonstrated. In this regard it is anticipated that stimulation will be derived from the accomplishments of recognized leaders, specialists in psychiatry, in the civil community.

Attention has been directed to the fact that the most important mission of the peace-time combatant organizations, aside from the normal activities with relation to maintenance and training, is that of preparation for war. Plans anticipating very rapid expansion of the forces in such a contingency must of necessity include provisions for additional medical personnel that will be utilized in connection with mobilization and the subsequent activities at home and in the field. This additional personnel, to be procured through the various reserve organizations authorized by law, will be absorbed by the Army and Navy in accordance with detailed plans prepared in advance. Some physicians, it is assumed, will be designated as administrative advisers

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to the authorities formulating plans for the training of officers and noncommissioned officers; others will be ordered to staff mental hospitals and still others will formulate units to conduct the required examinations in connection with new recruits in cantonments and training stations.

Since the mere listing of psychiatrists and a plan looking toward their designation within the Services could not by any stretch of the imagination insure success based on efficiency, these steps were preceded by one having a definite bearing on that point. I refer to the careful selection of physicians made on entrance to the Medical Reserve Corps. It may not be generally realized, but actually each individual applying for entrance was evaluated on the basis of personal and professional attainments prior to acceptance. The addition of this outstanding group to the nucleus of regular officers already in the Service should afford a splendid foundation on which to build.

In conclusion, the writer will quote, for its general interest, from a memorandum submitted by the William Alanson White Psychiatric Foundation on the utility and scope of possible psychiatric activities within the armed forces in the event of war.

War is an unitary performance of the whole people. The processes going on in the "home front" must be coordinated exactly with the combat arm; the entire socio-economic structure has to be united in prosecuting a war and this requires a great many integrating administrative activities. While efficient manpower at the front is indispensable, the prompt supply of war materials and provisions to the combat units is essential. Manpower implies high morale and strong motivation. Hunger, physical illness, and exhaustion from too prolonged demands are fatal to manpower. Here again we encounter the intra-service and extra-service relationships, now much more complex and endowed with an extreme of urgency. The men in the battle positions need as much of a feeling of personal security as can be given them. They are far more conscious of their utter dependence on others than is the man in the street in civil life. The timing of events stands out in glaring relief as a life-and-death matter. The concentration on military objectives reduces the field of those distractions that makes it easy for us to rationalize the inadequacies and oversights of friends, or to forget the slights and slanders of hostile persons; the indispensable solidarity that arises in the feeling of fraternity and collaboration is thus peculiarly exposed to incidents of injustice and discrimination and to paranoid attitudes of suspicion and distrust of unit leaders or subalterns. The recurrent experiencing of sudden death or devastating injury of comrades strips away much of our traditional envelope of reassuring beliefs and calls out attitudes in which survival techniques have the highest value. Clearly recognized danger becomes the characterizing mental state (in contradistinction to the neurotically masked anxiety so prevalent in urban civil life). Fear is transmuted by strong motivation into disciplined precaution and, as long as morale is high, into courageous actions. Personalities already heavily burdened by anxiety are apt to break down under this stress and to be disabled by acute anxiety states, the so-called shell-shock, or by panic. The prevention of these acute disturbances is the more important because of their "psychic contagiousness," their tendency to spread through the unit, and rapidly to disable others whose feeling of personal security is threatened from within. This calls for immediate effective therapy or prompt evacuation of all affected personnel. As this is always costly to combat

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efficiency and often entirely impractical, precautionary measures are vital. These preventive steps reach through all intermedate steps in the training of the men into the home front itself. The production and maintenance of morale is a psychiatric problem that affects the whole nation at arms, the worker and farmer, the parent and teacher, the civilian administrative personnel, the executive departments, and the entire military and naval establishment. The protection of morale, of concentrated motivation, and of solidarity are much more economical than are remedial efforts after disastrous failures at the front.

PSYCHIATRY AND THE NATIONAL DEFENSE [1]

By Harry Stack Sullivan, M. D., New York City, New York [2]

Each democratic people must look now to its capabilities for self-defense against force and threats of force that already are subjugating sundry free peoples of Europe and Asia. Our United States must increase its defensive aims and must go realistically about organizing all those supporting agencies that are needed for our adequate protection at minimum cost in lives and in economic hardships to posterity.

There is a special urgency in the preparedness of psychiatry. This is a function of its rapid growth, its complex field, and its vast potentialities.

The greatest weakness of a democratic state inheres in the substitution of faith and hope in lieu of adequate information on the part of the citizen. It once was easy to believe that the Nation could spring to arms. It is now easy to hope that the oceans will protect us from European and Asiatic destructiveness. It is comfortable to have faith that the Government will magically take steps adequate to the perfection of defensive measures.

To be really secure in its strength the United States must become a nation of people clearly aware of their several duties and responsibilities in a defense of the homeland, and well informed in the particular technical performances that would be required of each of them in times of need. Only by this type of preparedness can we certainly guarantee peace.

This does not mean that we must become what Lasswell has called a garrison state. It does not mean that we must abandon our relatively free society for one dominated by a military bureaucracy. It does not mean that we must all be stereotyped by compulsory military training to an unthinking automatic obedience.

It does mean that our movements towards freedom in the pursuit of truth, beauty, and humanity are no longer guaranteed by treaties and accords and balances of power. If we wish security in progressing

[1] Published in the February issue of Psychiatry, Journal of the Biology and the Pathology of Interpersonal Relations, 1835 Eye Street NW., Washington, D. C., as an editorial and submitted concurrently to the Bulletin for publication.

[2] President, William Alanson White Psychiatric Foundation, Washington, D. C., and Member of the Editorial Committee, Psychiatry, Journal of the Biology and the Pathology of Interpersonal Relations.

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towards such freedom, we must devote some part of each day to guaranteeing it. And the greater an individual responsibility we carry by virtue of the potentialities of our particular interests and techniques, the more diligently and thoroughly must we attend to preparation for service to the Nation.

Psychiatry has an indispensable role in the effective management of the armed forces in times of crisis, in their conservation in inter-crisis periods, and in their use in the prevention of crisis. The psychiatry of today is grossly inadequate to the assumption of this role and to the successful discharge of its responsibilities.

As Captain Sutton indicates, in the preceding article on Utilization of Psychiatry in the Armed Forces (published concurrently in the February issue of Psychiatry, Journal of the Biology and the Pathology of Interpersonal Relations), a modern psychiatry if not actually born in, at least received its integrating drives in the World War. From demobilization to date it has grown and grown lustily, but its course of development has been definitely wayward. It has progressed along many divergent lines but it has synthesized little widely available knowledge from its many insights into life.

Psychiatrists have tended to be intensely individualistic and their national organization has remained rather primitive, excepting for its annual scientific congress. It publishes a list of members and a bi-monthly journal that reports a number of the scientific papers. There is, however, no scientific professional directory, no survey of research findings, projects, and personnel, no organization of psychiatric curricula, and little if any supervision of training facilities.

In keeping with current medical political trends, it sends three delegates to a Board of Neurology and Psychiatry which, on payment of a fee, awards diplomas of qualification to practice the speciality to persons qualified by length of association with the specialized practice and to those others who satisfy the Board as to their competence in this relatively indeterminate field. This is an American Medical Association pattern: influence is concurrently brought to bear on governmental, educational, and other institutions to restrict the services of psychiatrists to the holders of these diplomas.

Much more significantly for the growth of psychiatry as a body of fact and technique, the American Psychiatric Association has in the last few years established qualifications (additional to length of membership) for election to Fellowship in the Association. If these qualifications are rigidly enforced, Fellowship will gradually come to indicate adequate experience and demonstrated competence in some field of psychiatric research or practice.

A rapid mobilization of psychiatrists today would be much what it was in 1917.

The practice of psychiatry may be classified as preventive, therapeutic, or custodial. Far the greater number of psychiatrists today are chiefly experienced in the more custodial aspects of treatment only. From the standpoint of national defense, this is the least significant class of psychiatric practice.

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A good many of the psychiatrists who are currently interested in more intensive forms of therapy place dependence on techniques that can scarcely be regarded as now of widespread practical significance, and that certainly are not readily adaptable to the necessities of combat service.

The recent, in some places quite unbridled, interest in pharmocodynamic shock therapy is also far from the service ideal, and its exponents as yet show little tendency to develop what might be called therapeutic perspective. It would not be surprising if one of these enthusiasts were to recommend metrazol convulsions as the ideal treatment for cases of "shell shock." It might even transpire that a preliminary convulsion would be recommended on the way to combat positions—to remove the terror of the known destructiveness, a trifle compared with terror connected with the convulsion.

A preventive psychiatry that can deal practically with regimented groups of adolescents and adults—the people making up the military and the naval forces—cannot readily be extrapolated from current child psychiatry, or from the experience of mental health clinics connected with high schools and colleges. A preventive psychiatry that can function dependably over the vast field from preventing dangerous fatigue of key men in high places, through all the relevant public relations aspects of the service units, through the intraservice perplexities and perturbations, down to the enlisted man discomposed by the death or dishonor of a really significant friend—such a preventive psychiatry which is a responsibility for the adequate discharge of which many psychiatrists should be competent, is certainly now but an ideal of the few.

The psychiatric study of vocational fitess is still rudimentary. Any psychiatric classification of personalities for technical, for combat, and for service of supply duties would for the most part have to be by trial and error. Yet there must be a good deal of reliable data, here and there, which could be formulated into a start in this direction. Captain Sutton has stressed the importance for national defense of really adequate techniques of this kind. Some work is already accomplished on the psychological side, and we need now to expand and refine this by data on demonstrable personality factors.

This general field of specific vocational fitness is greatly in need of psychiatric exploration, not only in the interest of national defense but also for the advancement of public welfare. The vast reservoirs of manpower now going to waste is the grevious shame of today; the disintegration of personality that attends this wastage is simply damnable. It is a satirical reflection on our best of possible worlds that only in times of national emergency does human ability stand out as the basic national wealth. In this connection one can note the almost universal approbation of the work of the Youth Administration

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and the C. C. C. camps. In the experience of this by no means adequately expanded effort, there is rich data for practical psychiatry in the service of the state.

The adequate survey of human material by means of scientific psychiatric techniques must gradually replace the present uncertain distribution of opportunities and responsibilities on purely fortuitous or on frankly prejudicial grounds. If the present disturbed state of the world hastens the general acceptance of this particular realism, there will have been something in it for which posterity may be thankful.

The adequate protection of peculiarly valuable personnel from insecurities arising within and outside of their individual personalities and interpersonal relations is a parallel development that is urgently needed. It will be a long time before high technical competence comes to coincide completely with full maturity of personality. In the abundant meanwhile we must pick our way to a rational differentiation of expectations as to particular people who have unusual functional significance, avoiding needless cultivation of juvenile or childish traits while at the same time providing the leeway needed for full expression of their peculiar talents and the progressive maturation of their personalities. The inclusion of such personal differentiation seemed impossible for service organizations, before the World War. Aviators, for example, then indicated its necessity.

One can but conclude that the evolution of good service psychiatry is something very much to be fostered, both in its own urgent right and in the interest of its great potential for contributing to a more widely useful civilian psychiatry.

RECRUITING DUTY

A PLEA TO MEDICAL OFFICERS FOR INCREASED EFFICIENCY

By Captain G. E. Thomas, Medical Corps, United States Navy, and Commander W. J. C. Agnew, Medical Corps, United States Navy

One of the most important functions of a naval medical officer is that of physical examination of applicants for enlistment. Medical officers attached to both Navy and Marine Corps recruiting stations are the ones who are called upon to render this service to the Navy.

Medical officers who are selected for this type of duty are sent immediately prior to such assignment to the naval recruiting schools at the naval training station at San Diego or Hampton Roads, for an intensive course of instruction along these lines. During their stay at these recruiting schools, medical officers are afforded an opportunity to witness the physical examination of incoming recruits by the medical officers attached to the training stations. In the majority of cases, when newly enlisted men (recruits) report for duty at the naval training station they have already accomplished their enlistment at the recruiting stations and are in every respect a potential unit of the personnel of the Navy.

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As soon as the recruits report at a training station, they are given their first meal and marched to the detention barracks where they are required to take a shower bath and then present themselves for a rigid physical examination. At this examination, which is most thorough, many physical conditions or defects which have been overlooked at the recruiting office are detected and recorded. It is regrettable to find at these examinations that an obvious physical defect has not been noted. When such a condition is found, the recruit is transferred to a naval hospital for disposition by medical survey for a physical condition or because of a disability which existed prior to entrance into the naval service.

The purpose of this article is to bring to the attention of medical officers on recruiting duty the importance of a thorough physical examination to detect the physically unfit before acceptance as a recruit. It is apparent that certain constitutional conditions may be present in an applicant for enlistment and that it is not possible to determine their existence during a physical examination at the recruiting station. However, the exercise of greater care on the part of the examining medical officer will result in lessening the number of medical discharges because of conditions which have no naval service connection.

Statistics from one of the four naval training stations are cited as an example:

During the calendar year 1937 a total of 5,578 recruits were received at the naval training station, San Diego, California, and started their training period. Of this number 66 were hospitalized before their training had been completed and were surveyed from the naval service with conditions which existed prior to enlistement and which were not aggravated by the naval service.

The following table indicates the diagnosis with which these 66 men were separated from the Navy:

Physical conditions:	
Enuresis	14
Painful flat foot	6
Valvular heart disease	5
Otitis media, chronic	4
Migraine	3
Malocclusion, teeth	2
Absence, acquired, lens right eye	1
Arterial hypertension	1
Asthma	1
Astigmatism	1
Bronchitis, chronic	1
Caries, teeth (20 cavities)	1
Cholangitis, chronic	1
Exopthalmic goitre	1
Hernia, inguinal	1
Hyperthyroidism	1

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Physical conditions—Continued.	
Myositis, chronic	1
Pyorrhoea alveolaris	1
Somnambulism	1
Ulcer, duodenum	1
Vincent's infection (Oral)	1
Mental conditions:	
Constitutional psychopathic inferiority without psychosis	4
Constitutional psychopathic state, emotional instability	3
Epilepsy	3
Psychosis hysteria	3
Dementia praecox	2
Psychosis unclassified	1

In cases of enuresis, somnambulism, chronic cholangitis, duodenal ulcer, and mental conditions, the examining medical officer cannot be expected to find the defects, but in other cases no difficulty should be experienced in immediate detection. In a large percentage of the cases the disabilities were found at the time of the first physical examination after reporting to the training station.

It is believed that the line officer at the recruiting station is in a position to assist the medical officer in noting anything peculiar about the applicant during his interview or when he is being examined in the intelligence tests. An emotionally unstable or mentally defective individual is very apt to demonstrate undesirability during an interview. Medical officers are not given the same opportunity to note these conditions because an applicant suffering from a mental condition is apt to be on his guard during the time he is with the medical officer. Closer cooperation between the line officer in charge and the medical officer at the recruiting stations might help to eliminate as rejections some of these applicants.

The revised NRB Form 24, which is an application for enlistment, was approved by the Bureau of Medicine and Surgery. The last page of this form is the applicant's physical questionnaire. This information is particularly valuable to the medical officers with whom the recruit comes in contact during his naval service, and it is especially valuable to the medical officers at the naval training stations. Until recently this information was not available to any medical officer except the one on recruiting duty. The recruiting section of the Bureau of Navigation is cooperating in every way with the Bureau of Medicine and Surgery and now the last sheet of NRB Form 24 is forwarded by the recruiting officer to the medical department of the training station to which the recruit is sent for training. This sheet contains on one side data pertaining to examination and on the reverse the applicant's physical questionnaire, which is indicated below:

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Applicant's Physical Questionnaire

(Name of applicant)

(Address) (City) (State) (Date)

These questions must be answered honestly by the applicant, and signed by him and his next of kin or the applicant's legal guardian

Have you ever had the following—	Other information
Asthma Heart trouble Head injuries Ear trouble Trouble breathing Hay fever Fits Dizzy or fainting spells or walking in sleep Lung trouble (any form) Chronic tonsillitis (sore throat) Are tonsils out Rheumatism Venereal diseases Rupture or hernia Did you ever wear a truss Piles Spitting of blood Urinated in bed in last 5 years Broken bones Stutter Chronic rash or pimples Do your legs or feet tire easily Operations (kind) Depressed arches or any indication of same or previous foot injuries Have you ever worn arch supporters Any insanity in family Do you wear or have you ever worn glasses Have you ever had a serious illness or been in a hospital? If so, give particulars Are you well	Have you lost or gained weight during the past 6 months? If so, how much? Family doctor's name: Address I certify that, to the best of my knowledge, the information given hereon is correct. (Signature of applicant) (Signature of next of kin or legal guardian)

The purpose of the article is to invite the attention of medical officers on recruiting duty to the importance of detection of the physically unfitted applicants for enlistment. By eliminating the physically unfit at a recruiting station the expense of transportation, uniform outfit, and equipment will be saved to the Navy, and a physically fitted recruit enlisted in place of the physically unfitted one.

ENDAMEBA HISTOLYTICA AND OTHER INTESTINAL PARASITES [1]

INCIDENCE IN VARIOUSLY EXPOSED GROUPS OF THE NAVY

By Lieutenant J. J. Sapero, Medical Corps, United States Navy, and C. M. Johnson, Sc. D., Protozoologist [2]

An investigation has been conducted to determine the incidence of *Endameba histolytica* in Navy men stationed in the American tropics and the Orient where amebic dysentery is endemic, and to estimate the

[1] From the Gorgas Memorial Laboratory, Panama, Republic of Panama, with the technical assistance of Lester E. Boston, chief pharmacist's mate, and Martine H. Williams, pharmacist's mate, first class, both of the United States Navy.

[2] The authors wish to acknowledge the generous assistance of the many officers of the Line and Medical Corps of the Navy whose splendid cooperation made possible the present investigation.

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danger of carriers in the dissemination of amebiasis in the Navy, and in the general population of the United States. In addition, the findings regarding intestinal parasites other than *E. histolytica* have been of considerable interest and are included in the present report.

INTRODUCTION

There are many indications that the amebiasis problem is of particular naval interest. Some 10,000 men of the service are stationed in parts of the world where amebic dysentery is highly endemic. The chances for acquiring amebic infections incident to such duty appear to be considerable. In the American tropics where many of the men remain on duty for a 2- or 3-year period, naval activities bring men into contact with a region termed by James [3] as "* * * one of the world's hotbeds of *histolytica* infection * * *." In the Orient where still larger numbers are stationed, amebic dysentery is even more prevalent.

In these parts of the world the combination of large numbers of carriers and the prevalence of insanitation greatly enhances the danger of acquiring infections. Ashore, the men often obtain food and drink prepared under unclean conditions by infected foodhandlers. Aboard ship, fresh provisions grown and handled by natives are served to the crews when food from more reliable sources is not obtainable. Furthermore, it is possible that the presence of carriers aboard ship, particularly those who handle food, constitutes an important additional source of infection.

From the civilian standpoint the main interest concerns the return to the United States of carriers of amebic infection, for these are potential sources for the dissemination of amebiasis among the general population. Johnstone and his coworkers [4] recently have stressed the epidemiological importance of such carriers, and Clark [5] warns that too little attention has been given to the possibility of disease introduction by returning soldiers and sailors who have been on duty in the tropics. One of the purposes of the present investigation, therefore, has been to evaluate this aspect of the amebiasis problem.

METHODS

The largest number of the examinations were done in Panama, where it was possible to survey variously exposed groups of Navy men. Three ships from the special service squadron were included in the study, in order to secure data on intestinal parasitic infections incident

[3] James, W. M.: Human amoebiasis due to infection with *Entamoeba histolytica*. Ann. of Trop. Med. & Parasitol., 22: 201-258, August 1928.

[4] Johnstone, H. G., David, N. A., and Reed, A. C.: A protozoal survey of one thousand prisoners. J. A. M. A., 100: 728-731, March 1933.

[5] Clark, H. C.: The development of international transportation and its effect on the practice of tropical medicine. Am. J. Trop. Med., 18: 1-7, January 1938.

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to tropical service. Men returning from the Orient were surveyed while en route through the Panama Canal. The rate of dissemination aboard naval vessels was determined by an examination of men attached to submarines.

A control group was examined to obtain the infection incidence in men without foreign service. This work was done on recruits at the naval training station in Norfolk, Va., and included men from all parts of the United States.

The technique of fecal examination for all groups was similar. Three specimens were obtained from each man. A cathartic of 2 drams of fluid extract of cascara sagrada was administered prior to the collection of the first specimen. Most of the specimens were received within 2 or 3 hours after passage; a few were as much as 8 hours old.

Andrews [6] states that conservatively estimated, a single purged stool reveals at least 75 percent of the protozoan species which might ultimately be discovered. The use of cathartics in the naval survey usually resulted in one or more of the specimens being of soft or mushy consistency, and therefore, it is believed that a large majority of the infections were detected.

The examinations of stools after cascara had the disadvantage of presenting the trophozoite to diagnose rather than the cystic form. Thus, for accuracy every diagnosis in the fresh saline preparation was checked by stained smears. For these, the rapid iron-hematoxylin method devised by Johnson [7] was employed.

The thinness of the saline smears decreased the chances of detecting the helminthic infections, and as neither flotation nor centrifuging technics were employed, many of the helminths were doubtlessly missed.

RESULTS

Control group.—It is evident from the data presented in table 1 that a high percentage of men entering the Navy harbor the dysentery organism, this being particularly true for recruits coming from the southeastern United States. The 14.7 percent incidence of histolytica in men from the South is nearly twice that of the other group which included representatives from all other States. As a result of these examinations, it is apparent that not only a considerable percentage of infections found in any subsequently examined group will have been acquired prior to naval service, but that the number of such infections will depend on the proportions of men from the south and from other parts of the country. Thus, in making later comparisons and using the Norfolk group as a control, allowance has been made for these previously acquired infections.

[6] Andrews, J.: The disanosis of intestinal protozoa from purged and normally-passed stools. J. Parasit., 20: 253-254, June 1934.

[7] Johnson, C. M.: A rapid technique for iron-hematoxylin staining requiring no microscopic control of decolorization. Am. J. Trop. Med., 15: 551-553, September 1935.

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TABLE 1

Intestinal parasites in Naval recruits—Control group

	Southern States	Other States
Total number of men examined	129	77
	Percent	*Percent*
Percentage of protozoal infections	63.6	48.1
Percentage of helminth infections	17.1	
E. histolytica	14.7	7.8
E. coli	39.5	28.6
E. nana	29.5	23.4
I. bütschlii	9.3	
D. fragilis	17.1	10.4
G. lamblia	7.8	5.2
C. mesnili	2.3	2.6
T. hominis	2.3	2.6
N. americanus	14.0	
T. trichiura	3.0	
Naval service: Average per man (weeks)	3.9	28.0

There was a marked contrast in the other parasitic findings in the two groups. Of the southern recruits, 63.6 percent of the men harbored some protozoan, and 23 of these had multiple infections with three or more protozoal species. Often enormous numbers of each protozoan would be encountered. In the "other States" group, less than one-half of the men were infected, and the intensities were correspondingly less.

All the helminthic infections were found in the southern recruits. *N. americanus* was the important species with an incidence of 14.0 percent.

Tropical exposure.—In table 2 the results of examinations are recorded for ships of the special service squadron. Each of the three vessels had been stationed in tropical waters for periods varying from 8 to 16 months. Two of the ships, destroyers, had made extended cruises throughout Central America, the men visiting both seaport and interior cities. At the squadron base in Panama, the important contacts were made ashore, usually in Panama City where the men frequently obtained food and drink in native eating establishments. Whether in Panama or in other Central American countries, the sanitary conditions encountered by the men were often unsatisfactory.

The total incidence of *E. histolytica* for the three ships was 9.5 percent. Although there had been considerable difference in the exposures of the crew of each individual ship, the infection rates for the three ships were practically the same. This suggests that no new infections had been acquired during this tropical duty. Furthermore, the rate for these men upon entry into the service may be estimated at 11 percent, an incidence representing the mid-point of the Norfolk extremes, as approximately one-half of the crews were enlisted in

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Southern States. Similarly, there was no evidence of dissemination within the crew of any ship, despite the presence of numerous carriers.

TABLE 2

Intestinal parasites in Navy men on tropical duty special service squadron

	Gunboat	Destroyers		Squadron total
		A	B	
Number of men examined	218	129	125	472
	Percent	*Percent*	*Percent*	*Percent*
Protozoal infections	33.0	38.0	48.0	38.3
Helminth infections	5.0	1.6	6.4	4.5
E. histolytica	9.6	9.3	10.4	9.5
E. coli	16.1	19.4	28.6	20.5
E. nana	16.5	18.6	23.2	18.9
I. bütschlii	3.7	2.3	3.2	3.2
D. fragilis	3.2	2.3	6.4	3.8
G. lamblia	6.0	5.4	7.6	6.1
C. mesnili	1.4	----	1.6	1.1
T. hominis	.5	----	1.6	.6
N. americanus	3.7	----	3.2	2.5
S. stercoralis	----	----	1.6	.4
T. trichiura	.9	.8	----	.6
T. hymenolepsis nana	.5	----	1.6	.6
A. lumbricoides	----	.8	----	.2
Average length of tropical service, months	8	15	16	13

The helminthic infections were not numerous. Hookworms were encountered in 2.5 percent of the men. All of these cases appear to have resulted from previous residence in endemic hookworm centers of the United States.

Submarine group.—Although no evidence of dissemination was found on the larger naval vessels, the crews of six submarines were surveyed as it seemed likely that duty on this type of ship would predispose to transmission. The internal arrangement of the *S*-boats is such that strict sanitary supervision of the messes and foodhandlers is more difficult than on larger vessels. The men live together in close associaton, often over a period of years. For this group the average time of submarine duty was 46 months.

There was, however, no evidence of dissemination (table 3), 9.6 percent of the men harbored *E. histolytica*. In estimating from the control study the number of infections in this group acquired previous to submarine duty, an almost identical percent of 9.0 was obtained.

The helminth indices were low. Hookworm, which was quite prevalent in the other groups, was found in but 0.8 percent.

Asiatic group.—In men returning from duty in the Orient, 26.1 percent of the men were found to be infected with the amebic dysentery protozoan as shown in table 3, 10.9 percent of the men harbored helminths.

In both instances, it is evident that new infections had been acquired, the indices being so high that comparisons with the control group are not required.

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TABLE 3

Incidence of intestinal parasites, U. S. Navy

	Sumbarine group [a]	Asiatic group [b]	Summary	
			Number	Percent
Number of men examined	251	92	1,021	
Percentage of protozoal infections	51.8	54.4	480	47.0
Percentage of helminth infections	1.6	10.9	57	5.6
E. histolytica	9.6	26.1	118	11.6
E. coli	23.5	28.3	255	25.0
E. nana	24.3	28.3	232	22.7
I. bütschlii	4.8	4.3	43	4.1
D. fragilis	6.4	2.2	66	6.5
G. lamblia	6.8	14.1	73	7.2
T. hominis	.8	3.3	13	1.3
C. mesnili	1.2	2.2	15	1.5
N. americanus	.8	3.3	35	3.4
T. trichiura		2.2	9	.9
T. hymenolepsis nana	.4		4	.4
A. lumbricoides		4.4	5	.5
S. stercoralis	.8	1.1	5	.5

[a] Average length of duty in submarine service: 46 months.
[b] Average length of duty in Asiatic service: 31 months.

The average length of service in the Asiatics for these men had been 31 months. They had been stationed in Peiping, Shanghai, in the Philippine Islands, and aboard ships of the Asiatic fleet.

General incidence of infection for all groups.—Including all groups, the results of which are summarized in table 3, a total of 1,021 Navy men were examined. Almost one-half of these harbored one or more protozoal species. The rate for helminths was 5.6 percent, of which *N. americanus* was by far the most prevalent. *E. histolytica* was found in 11.6 percent. This amebiasis rate is a fairly representative figure for the general prevalence of this infection in the Navy. The various groups represent a fair sampling of the service population. The high percentage of infections encountered in the Asiatic groups is included, for this unit comprised about one-tenth of the total number examined, which is a like proportion of the total naval forces actually stationed in the Orient.

DISCUSSION

Prevalence of amebiasis in the Navy compared to civilian population.—Although one would expect amebiasis to be more prevalent in a migrating population such as the Navy, remarkably enough, the naval incidence of 11.6 percent amebic infections is no greater than that reported for the civilian population of the United States. Craig,[8] in summarizing the reports on some 50,000 examinations conducted in various parts of the country by different workers, obtained an average incidence of 11.6 percent. For an age group similar to that of the Navy, Reed and Johnstone[9] report 9.2 percent infection in 1,000

[8] Craig, C. F.: Amebiasis and amebic dysentery. Charles C. Thomas, Baltimore, Md. Page 45, 1934.
[9] Reed, A. C., and Johnstone, H. G.: Amebiasis among one thousand prisoners. Am. J. Trop Med., 14: 181–189, March 1934.

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prisoners in a California institution. Wenrich and his associates,[10] doing single examinations upon college students, found 4.1 percent amebiasis, but concluded that the true incidence was probably closer to 10 percent.

Source of amebic infections encountered in the service.—From the epidemiological data obtained in the naval survey, it is apparent that a large majority of the carriers have become infected prior to enlistment in the Navy and incident to residence in the United Sates. This was well shown by the high prevalence of amebiasis found in recruits from all parts of the country. On the other hand, duty in the American tropics did not result in any appreciable number of men becoming infected, this in spite of the common belief that residence or travel in such endemic regions is dangerous. Furthermore, though without doubt there were many infected carriers serving food to the sailors both ashore and aboard ship, transmission by foodhandlers was not evident. One wonders if the greatly stressed importance of this means of dissemination, as noted by Craig,[11] Reed,[12] and many other authorities has not received undue emphasis.

The fact that the rate of histolytica infection in men from the Asiatics was trebled leaves no question of the hazard of acquiring amebiasis in that part of the world. It is evident that the men experience very different conditions of exposure in the Orient. It is quite probable that the widespread use of night soil in the growth of garden foodstuffs may be of importance, though the general lack of proper sewage disposal in some parts suggests the possibility of many other means of fecal contamination of food or drink.

One may conclude, with the exception of the difficult problem encountered in the Orient, that sanitary regulations in the Navy at present are on the whole effective safeguards in the control of the transmission of amebic infections. However, the fact that there are estimated to be some 15,000 carriers in the Navy clearly points to the necessity for rigorous sanitary maintenance. Unfortunately, it is not feasible to detect and treat this large number of cases by any practical methods available at the present time.

This conclusion also holds true for the detection of carriers upon discharge to civilian life. But, aside from this, when one considers the millions of carriers already existent in the civilian population of the United States, the number of carriers among discharged sailors are by comparison an unimportant source of the spread of the amebic infections.

Morbidity from amebiasis in the Navy.—The fact that amebic dysentery is on the increase in the Navy indicates that all aspects of

[10] Wenrich, D. H., Stabler, R. M., and Arnett, J. H.: The incidence of the disease-producing amoeba (*Endamoeba histolytica*) in 1,060 college freshman and its significance. Science, **79**: 143–144, February 1934.

[11] Craig, C. F.: The epidemiology of amebiasis. J. A. M. A., **103**: 1061–1063, October 1934.

[12] Reed, A. C.: Clinical amebiasis and newer methods of treatment. Northwest Med., **30**: 525, December 1931.

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the problem are deserving of careful consideration. Stuart [13] in 1928 pointed out that the disease rate for the Navy had increased from 27/100,000 in 1917 to 34/100,000 in 1926, or an average rate for the 10 years of 25/100,000. Statistics for 1936,[14] 10 years later, indicate a further rise in the occurrence of dysentery, the 5-year median rate amounting to 55/100,000. However, it seems quite possible that this may be due to the recognition of larger numbers of cases as a result of modern advances in the knowledge of dysentery.

It is interesting to note, however, that on the basis of this 5-year rate for dysentery and 11.6 percent incidence of carriers, only 4.6 cases of clinical dysentery occur in the Navy for every 1,000 carriers of *E. histolytica*. This remarkable ratio is one of the major unexplained problems in amebiasis. No one has been able to demonstrate the mechanism which precipitates the dysenteric syndrome.

While these relationships between carriers and those ill from this protozoan are highly significant, they do not include morbidity which many observers are emphasizing as being due to the presence of the organism and yet not commonly recognized. It is becoming more evident that illness grading from mild, unimportant symptomatology to advanced and severe disease may result from this parasite and be unaccompanied by dysentery. Indeed, Craig [15] states that no less than 65 percent of all carriers have definite symptoms referable to *E. histolytica*, and has emphasized the frequency with which such cases are overlooked when search is not made for the causative ameba. One need only to study the diagnostic difficulties experienced during the Chicago outbreak of dysentery in 1933 [16] to be convinced of the protean nature of the clinical manifestations of this parasite, and the ease with which the proper diagnosis may be missed.

Intestinal parasites other than E. histolytica.—Of the helminths, it appears that *A. lumbricoides* and other intestinal worms are acquired incident to duty in the Orient. The findings concerning protozoa other than *E. histolytica* coincide, in general, with those of other workers. They may, however, serve as a guide for the frequency with which intestinal parasites should be encountered in naval laboratories doing this type of work.

The incidence of *Dientameba fragilis* reported in this study is perhaps worthy of particular note. Until recently this protozoan was considered relatively rare; yet in the Norfolk southern group it was encountered in 17.1 percent of the men, and in recruits from other parts of the country in 10.4 percent. The average incidence in all

[13] Stuart, M. A.: General considerations on amoebic dysentery and *Endamoebic* carriers. U. S. Nav. Med. Bul., 26: 411–438, April 1928.

[14] Statistics of Diseases and Injuries in the United States Navy. For the calendar year 1936. U. S. Government Printing Office. Washington, 1938.

[15] Craig, C. F.: Amoebiasis and amebic dysentery. Charles C. Thomas, Baltimore, Md. Page 122. 1934.

[16] Epidemic amebic dysentery. National Institute of Health. Bul. No. 266: 93–130. U. S. Treasury Department, Washington, D. C., 1936.

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groups was 6.5 percent. This high prevalence is of interest in that *D. fragilis* has been suggested by Hakansson [17] and others, as a possible human pathogen.

SUMMARY

1. The examination of 1,021 men of the Navy revealed 11.6 percent infections with *Endameba histolytica*. The major proportion of these infections were incident to residence in the United States, prior to naval service, as indicated by 14.7 percent infections in recruits from the southeastern part of the country, and 7.8 percent in those from other parts of the United States.

2. For men on duty in the American tropics, a highly endemic region for dysentery, the rate was 9.5 percent. On the other hand, for men returning from the Asiatics 26.1 percent infections were found.

3. There was no evidence of transmission of the dysentery organism aboard naval vessels. In submarines selected as a type of ship in which dissemination was most likely to occur, the rate was 9.6 percent.

4. The numbers of infected men returning to civilian life upon discharge from the naval service cannot be considered an important source of infection to the civilian population of the United States.

5. The increase in clinical amebic dysentery in the Navy during the last 20 years indicates the necessity of maintaining rigorous sanitary control. For every 1,000 carriers of the dysentery organism in the Navy, there are but 4.6 cases of dysentery, but it is stressed that the actual morbidity from *E. histolytica* is probably much greater than these statistics would indicate.

6. Hookworm occurred in 14 percent of southern recruits and its incidence remained fairly high in other groups. All of these infections appear to have been acquired prior to naval service. Ascaris and other helminths were acquired during service in the Orient. The incidence of 17.1 percent of *Dientameba fragilis* found in one group, is the highest which has been reported in the United States.

CHOLERA IN SHANGHAI WAR REFUGEES

By Lieutenant A. R. Higgins, Medical Corps, United States Navy

During the recent hostilities in the Shanghai area, the influx of war refugees was enormous. The resultant crowded thousands of these poverty-stricken, undernourished, and physically dirty refugees expressed itself in an increased incidence in the city of those diseases resulting from poor hygiene, notably cholera. The almost unbelievably low standard of living obtaining among the lower class native in normal times was made even worse, with the result that great numbers had no dwelling, sleeping in the streets, and obtaining food from any source, often from refuse. This occurred in spite of the

[17] Hakansson, E. G.: *Dientamoeba fragilis*, a cause of illness. Am. J. Trop. Med., 16: 175–184, March 1936.

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efforts of relief organizations, which were inadequate in the face of such an added burden. Since the summer of 1937, when the refugee problem first became acute, stress has been properly laid on the prevention aspects of cholera, and an attempt has been made to secure mass cholera immunity by wholesale vaccination. This appears to have been fairly satisfactory, although accurate figures are not yet available. To an observer who has not seen clinical cholera, however, the treatment of a case of cholera is no less dramatic than its prevention, and is here reported.

A typical cholera hospital, organized since the beginning of the refugee problem in July 1937, is a converted dwelling house, into which 150 beds have been crowded. No foreign patients are treated here, and only indigent natives. The equipment is decidedly meager, with only rudimentary bathing and messing facilities. The beds are frame hospital cots, benches, or mats on the floor. Instead of mattresses, the cots have a porous mesh woven of hemp. A shallow galvanized iron pan, 6 by 4 feet is placed under the bed in the actively purging cases, and a cuspidor placed to receive vomitus.

Two full-time Chinese physicians are in charge. Cases are first seen in an admitting room, and a clinical diagnosis is made. Without very adequate laboratory facilities, these physicians state that a reasonable accuracy in diagnosis is attained by a careful history; particularly significant is the presence of painless purging, characteristic vomiting, dehydration, rice water stools, and, in the more serious cases, aphonia. An attempt is made only to hospitalize the more urgent cases, perhaps some 5 to 10 percent of all applicants who are clinically diagnosed as cholera. The remaining applicants are neither treated nor quarantined. These patients are left to shift for themselves, since their management is economically beyond the power of the medical attendants.

On admission, the patient goes directly to the saline infusion room and is placed on a cot of the type described. Bathing, and other usual admission ceremonies, are omitted. The trousers are pulled down, defecation proceeds through the porous web into the cresol solution in the pan below, and vomitus is received into the cuspidor. Stool specimens are taken from excreta on the webbing, in the few cases in which laboratory confirmation of the diagnosis is done. Immediately on admission a saline venoclysis is begun, with the following interesting technic:

Singly distilled water is made into normal saline solution by the addition of a good grade of table salt. The solution is autoclaved and placed in a cylinder on a shelf 6 feet above the arm level. A Murphy-drop gauge is placed in the line for control of the rate of flow. The rapidity of administration of the solution is surprising, in most cases being in excess of 2,000 cc. per hour. In a case observed, 7,000 cc. had been given in 2 hours. Amounts as high as 16,000 cc. in 24 hours are not unusual in adults.

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Intravenous "reactions" are naturally present, with such rapidity of infusion and method of preparation of the solution. This event, however, is not considered a contraindication to further administration of saline, which is continued until the pulse, commonly imperceptible on admission, is reasonably good, and the temperature rise approaches normal. Clinical improvement is at this time dramatic. At the conclusion of this single massive saline infusion, the majority of patients are considered convalescent; the purging and emesis stop, and in many instances the patient or his family insist on his return to his home. Relapses are few. The death rate among those cases hospitalized during this epidemic (1937) has been approximately 7 percent, with most of these deaths occurring in otherwise diseased or senile patients.

Convalescent management is largely rest, with continued forcing of fluids by mouth. Messing of the sick is distinctly not a problem, for the reason that as soon as the patient can take rice water, he is discharged. For the usual 2 to 3 days following the admission venoclysis, the patients are crowded into small convalescent rooms, with sexes and ages intermingled. No attendants are provided, and the usual duties of the orderly and nurse are performed by family or friends. Almost no medication is given. In most cases, the patient supplies his own bedding, and he remains in the same clothes in which he entered. Since even these poor living accomodations are in most cases better than the patient has been accustomed to, he does not complain, and the morale in these wards is excellent.

The management of this extremely active hospital, with rapid turnover of almost universally moribund patients, and on an infinitesimal budget, furnishes an interesting lesson to one accustomed to the expensive accessories of an American hospital. The administration of intravenous saline solution in such massive quantities, and with such a simplified technic, would appear to be a fearsome procedure until the spendid results are witnessed. The picture described is, of course, only that which pertains to the handling of cholera in refugees. who would otherwise be without care.

OBSERVATIONS ON TETANUS IN GUAM (1905 TO 1937) [1]

By Lieutenant M. W. Arnold, Medical Corps, United States Navy, and Lieutenant T. W. McDaniel, Jr., Medical Corps, United States Navy

At the height of the disease, every organ of voluntary motion seems to be affected; and amongst the rest, the muscles of the face. The forehead is drawn up into furrows, the eyes, sometimes distorted, are commonly rigid, and immovable in their sockets; the nose is drawn up, and the cheeks are drawn backwards toward the ears, so that the whole countenance expresses the most violent grinning. This is what has been named the lockjaw. Under these universal spasms a violent convulsion commonly comes, and puts an end to life.[2]

[1] From the U. S. Naval Hospital, Guam, M. I.

[2] William Cullen, M. D.: First Lines of the Practice of Physic, vol. 11, par. 1260. (Published by Parkers, Philadelphia, 1816.)

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It remains as true to-day as it was when written by William Cullen over a century and a half ago that tetanus has its greatest prevalence in the tropical climes of the earth. Conditions of hereditary and environmental background, climatic factors, lack of full appreciation of the benefits of preventive medicine, educational deficiency, poverty, ignorance, and indifference have maintained in Guam amongst the native Chamorron population a combination of situations extremely conducive to a high tetanus morbidity and mortality rate. Similar conditions, of course, are commonly encountered in most tropical lands of the world, and are in no manner peculiar to this island.

The material for this study is based upon the naval hospital records for the years 1905 to 1937, inclusive. Much data is lacking, due to destruction of a large number of hospital records by flood and typhoon, thus it is not presumed that we have covered statistics on tetanus in Guam as completely or unerringly as we might have, had full information been available. But, fortunately, there remains sufficient material to statistically prove the almost unheard-of discrepancy in mortality rates obtaining prior to 1925 compared to those observed since that time.

Covering the period noted (1905 to 1937) there are on record 71 cases of tetanus, of whom 52 died. These cases are arbitrarily divided into periods, those occurring between 1905 and 1924 and those of 1925 to 1937, primarily because of the sharp drop in mortality beginning in the year 1925. Tables 1 and 2 explain themselves:

TABLE 1

Tetanus mortality, 1905–24

Type of tetanus	Total cases	Recovered	Died
Generalized	20	0	20
Neonatorum	21	0	21
Total	41	0	41

Mortality rate: 100 percent. Guam population: Varied from 10,000 to 15,000.

TABLE 2

Tetanus mortality, 1925–37

Type of tetanus	Total cases	Recovered	Died
Generalized	29	18	11
Neonatorum	0	0	0
Localized	1	1	0
Total	30	19	11

Mortality rate: 36.6 percent. Guam population: Varied from 15,000 to 21,000.

Thus, it can be seen that both the morbidity and mortality rates dropped sharply in the second period. The absence of cases of tetanus

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neonatorum since 1925 bespeaks the gratifying results of an educational campaign for the instruction of midwives begun in the days before the World War and followed up to the present time. Most all of the recorded cases of tetanus neonatorum occurred from 1905 to 1913 during which time the disease was written of in annual hospital sanitary reports as an alarming and serious one for babies on the island. Some physicians in those days recorded these cases as "cord-tetanus" and often as "tetanus of the umbilical cord." No cases were noted of uterine tetanus such as those arising from self-inflicted abortion. It is striking, however, in the older records how often no portal of entry for tetanus organisms was discovered.

Surg.-Gen. Sir David Bruce, of the British War Office Committee,[3] submitted the following mortality on cases of tetanus treated in home hospitals during the World War:

TABLE 3

Tetanus mortality in British troops

Years	Cases	Died	Percent
1914–15	231	133	57.6
1915–16	195	96	49.2
August–October 1916	200	73	36.5
October–December 1916	100	31	31.0
December 1916–March 1917	100	19	19.0

It can be stated that in these cases education in prophylaxis, the immediate control of troops, and rigid surveillance were much more possible than in such divers groups as are encountered in Guam, over whom no strict military discipline and training are practiced. Of greatest importance in the British Army was the rigid institution of antitoxin prophylaxis and the adoption of the newer ideas of wound excision, debridement, and antisepsis, coupled with the exhibition of the entirely novel method of treating tetanus with enormous doses of antitetanic serum intramuscularly and intrathecally. It is to be noted that regardless of the increased number of men thrown into action as the war progressed, there was an almost steady decline in not only the mortality, but what is equally remarkable, the percentage incidence of tetanus.

A critical analysis has been undertaken of the 13 cases of tetanus occurring in Guam since 1932 on whom clinical charts are available. The motive of this has been to attempt an elucidation of what is typical in symptomatology, clinical course and signs, and what is most valuable in treatment and prophylaxis. Modes of treatment are submitted. Evident errors in prophylaxis and therapy are reviewed because we wish to stress the possibility that they might have been avoided,

[3] War Office Committee for the Study of Tetanus (Great Britain): Memorandum on Tetanus, ed. IV, 1919.

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had specific cognizance been held of the bitter experiences of World War physicians on the Western Front, where the proper prophylaxis and treatment of tetanus were elaborated and to which very few things of value have been added since. All modern treatises reflect almost word for word those experiences, and they should, of a certainty, be the working armamentarium of every naval medical officer the moment he is confronted with a wound, the like of which is tetanus laden. There is scarcely any chapter in hospital experience which is more dramatic and stirs up the attention and zealousness of doctors, nurses, and corpsmen alike than the sudden appearance of a full-blossomed case of tetanus in their midst. Once seen, it is never lost to memory. Statistics may be cited to indicate that there may be more or there may be less than a 50-percent chance of saving the life of the afflicted, but the physician in attendance will know that he is at grips in a real battle. But, when armed with the counsel of those in the World War who had the real experiences with the disease, the chance of success may be elevated from 50 percent to possibly 80 percent. Not much more success can be expected under the methods now prevailing. Table 4 depicts a few facts concerning the 13 cases studied:

TABLE 4

Data on 13 cases of tetanus in Guam

Location of wound, type and cause	Incubation period, (days)	Prophylactic dose, (units)	Routes of administration of anti-tetanic serum dosage reported in multiple of 1,000 American units					Result
			Intrathecal	Intravenous	Intramuscular	Subcutaneous	Around the wound	
Nail puncture, left foot	10	1,500	10	80	----	-----	15.5	Recovered.
Not known or discovered	Unknown	None	40	90	----	-----	20	Do.
Nail puncture right foot	4	----do	20	60	20	6	20	Do.
Splinter of wood dorsum, left foot.	3	----do	60	80	40	1.5	40	Do.
Not known or discovered	Unknown	----do	80	40	60	-----	20	Do.
Splinter of wood, right foot	7	----do	50	85	75	-----	40	Do.
Laceration, nose fall on ground	5	----do	20	90	30	-----	-----	Expired.
Nail puncture, left heel	12	----do	4	31	----	-----	7.5	Do.
Not known or discovered	8	----do	40	40	----	2.25	-----	Do.
Penetrating wound dorsum, left foot.	7	----do	10	10	----	-----	5	Do.
Lacerated wound, left foot	Unknown	----do	30	30	10	-----	-----	Do.
Not known or discovered	----do	----do	10	----	45	30	-----	Do.
Wound 8 inches long, exposing Hunter's Canal. Gored by a Carabao.	7	1,500 on admission, 1,500 6 days later.	30	280	40	3	60	Do.

By word of further explanation, all these cases had local treatment of the original wound or portal of entry of tetanus organisms, varying from simple application of different antiseptics (mostly oxygen-liberating) to complete excision or cauterization. The most favored method was surgically laying the wound wide-open, removing *in toto*

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all necrotic tissue down to an oozing, clean base, and frequent washing of the part with hot solutions of oxidizing agents. Cauterization, occlusive dressings, ointments and the halogen antiseptics were rarely employed. Present-day opinion holds that cauterization of the wound by lunar caustic or by electro-coagulation is contraindicated, primarily for the reason that the resultant necrosis and sloughing tissues present a favorable environment and culture-medium for anaerobic growth.

The following observations and deductions may be made from study of the 13 cases:

(1) Moderate leukocytosis is the rule with the polymorphonuclear neutrophiles, without toxic left shift, predominating both absolutely and relatively.

(2) The degree of leukocytosis does not parallel the severity of symptoms or reflect the ultimate outcome of the case.

(3) With very high temperatures, blood-cultures should be made, for as with any primary wound pyogenic bacteriemia may occur and probably does occur much more often than is realized. As in one of our cases, a blood leukocyte count of 23,000 with 92 percent polys and a temperature of 105.2° gave a lead for obtaining a blood culture. The result was a luxurious growth in pure culture of an hemolytic staphylococcus within 24 hours. In such a case Prontosil might advantageously be given in addition to the regular tetanus regimen. The much-praised merits of Prontosil, coupled with the infrequency with which blood cultures are made in tetanus cases, suggest that an extremely valuable addition to our therapy of tetanus of the hyperpyrexia type might be lying dormant by the wayside. Prominent regional cellulitis, lymphangitis, and lymphadenopathy are not always present as premonitory signs of pyogenic invasion of the blood stream, and we believe that it is erroneous to await their visible or palpable presence before the easy, simple blood culture is made. By the "Hippocratic Law of Tetanus" we can not afford to lose time in treating whatever type of bacteriemia we might be dealing with.

(4) More spinal fluid cell counts, differential counts, and cultures should be made. Seven of our series showed cellular increases ranging from 21 to 1,450 per cu. mm. of spinal fluid, with an average of 358 for the series. Smears for staining, differential counts, and cultures were not made in any of these cases. What the predominating cell is in the spinal fluid of a tetanus case and what significance can be attached to the increased total cell count of the spinal fluid are problems which we are unable to find commented upon in the literature of tetanus. We can state, however, that in our cases no correlation exists between increased spinal fluid cells and the gravity or prognosis of the case.

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(5) Increased body temperature is the rule. In the year 1816, Charles Caldwell, M. D., wrote of this fact as follows:

> We do not recollect ever to have seen a case of tetanus in which the patient was entirely exempt from febrile action. At the commencement of the disease, the pulse is oftentimes full and frequent, tense, and strong.[3]

(6) The incidence in males as compared to females in Guam is 11:2. William Cullen wrote prior to 1790:

> Though the causes mentioned do, upon occasion affect all sorts of persons, they seem however to attack persons of middle age more frequently than the older or younger, the male sex more frequently than the female, and the robust and vigorous more frequently than the weaker.[3]

The increased hazards of the outdoor life and occupational pursuits of males in Guam no doubt play a strong part in this great difference in sex incidence of tetanus.

(7) Of the generalized tetanus cases tetanus antitoxin was administered prophylactically in only 1 case out of 12. This is a very remarkable fact primarily because the figures at this hospital show that during the period from July of 1927 to July of 1937 there were given 3,557 doses of 1,500 U each of antitetanic serum to approximately 3,500 patients with injuries the nature of which warranted tetanus prophylaxis. Of these 3,500 patients only one developed clinical tetanus, and the exigencies surrounding this case are described under the section on prophylaxis.

(8) The total number of American units of tetanus antitoxin given therapeutically for all cases of tetanus for the past 10 years in Guam was 4,180,000, averaging 139,000 U for each case. Then, combining the data of (7) and (8) we have the facts of table 5:

TABLE 5

Tetanus antitoxin, quantity and cost

1927–37, total prophylactic U: 5,335,000, cost	$2,276.48
1927–37, total therapeutic U: 4,180,000, cost	1,901.31

It can be seen, then, that the treatment of 13 cases of tetanus cost much more than the temporary immunization of 3,500 persons with antitoxin, when the collateral expenses of hospitalization, nursing care, professional service, laboratory and other diagnostic procedures, and medications are added to those of therapeutic antitoxin.

Thus, the tetanus problem is also an economic one, and these figures for Guam are offered in further support of the contention of L. Bazy [4] who proposes the wide-scale exhibition of alum-precipitated tetanus toxoid to those people whose occupational pursuits

[4] Bazy, L.: Documents pour servir à la prévention du tétanos. Immunisation active par le vaccin ou immunisation passive par le sérum? Bull. et mém. Soc. Nat. de Chir., 61: 714, 1935.

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expose them particularly to the tetanus hazard. Bazy states that in France where there is much tetanus and where a veritable fear of tetanus exists among the population the annual cost of antitetanic serum, which is only temporarily immunizing, amounts to 6,500,000 francs. He further figures that 650,000 people could be permanently immunized against tetanus for that sum each year in France.

Aside from these economic considerations, the toxoid would prevent the development of tetanus in those two groups which are always the greatest problems and from whose ranks the greatest number of cases, by far, occur. Those are the cases of endogenous tetanus in which no primary wound is discernible and the trivial injuries such as minor lacerations and penetrating wounds the seeming insignificance of which causes the patient to use home treatment, and thus go without the lifesaving serum. At least, by comment it is interesting to note that in France, each year, antitetanic serum is given at a cost sufficient to permanently immunize almost the entire personnel of six navies the size of that of the United States with the newer toxoid.

We might add that the people most likely to get tetanus are preponderately males of the active type in many lines of physical labor, and especially in military circles the active-immunization of them alone would be a great step forward. We must not overlook the established fact that for many a century tetanus has been written of as a disease woefully common in military life, and more exactly in actual warfare. In a table by Hinterstoisser, quoted by MacConkey,[5] tetanus in various Wars was recorded as follows:

TABLE 6

War tetanus

War	Number wounded	Cases of tetanus
Crimean	12,094 (English)	19
American Civil War	217,000	505
Russo-Turkish War	51,700 (Russian)	66
Franco-Prussian War	95,000	250
World War (2 months, 1914)	27,677 (German)	174
World War (1918)	380,000 (British)	292
World War (first 3 months)	20,761 (British)	153
World War (entire period)	Unknown (British)	1,450

An outstanding example of what educational campaigns can accomplish in the prevention of disease is that of the American Medical Association and the phenomenal diminution in Fourth of July tetanus in the United States, as follows:

[5] MacConkey, A. T.: The Prophylaxis of Tetanus, Brit. M. J. 2:849, 1915; ibid., Tetanus: Its Prevention and Treatment by Means of Antitetanic Serum, 2:609, 1914.

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TABLE 7

Fourth of July tetanus, United States [a]

Year:	Deaths
1903	406.
1904	91.
1905	87.
1906	75.
1907	73.
1908	76.
1911	10 (out of a total of 18 cases).
1912	6 (out of a total of 7 cases).
1913	3 (out of a total of 4 cases).

[a] This table is taken from the statistical returns in the United States as related by J. G. Fitzgerald. Fitzgerald, J. G.: Tetanus: Nelson's Loose-Leaf Living Medicine, 2: ch. XXXVII.

TREATMENT OF TETANUS

When the disease is known to arise from the lesion of a nerve in any part of the body, the first, and as I judge, the most important step to be taken toward a cure, is by every possible means, to cut off that part from all communication with the sensorium, either by cutting through the nerves in their course, or perhaps by destroying, to a certain length, their affected part or extremity—Cullen,[2] 1816.

The usual and best preventives of tetanus from external injuries, consist in the conversion of punctured into incised wounds, by means of the scalpel, and the excitement of suppuration in wounds that are lacerated. These things, if done immediately after the injuries have been received and before the occurrence of tetanic symptoms, are of high importance; but they are worse, perhaps, than nugatory—they are nothing, in general, but useless torture if delayed until the disease shall have made its appearance. When the tetanic diathesis is fairly formed, all local applications to the injured part are unavailing, even the amputation of the limb itself has been found insufficient to arrest the complaint—Caldwell,[3] 1816.

These statements, aside from their historical interest, are brought forward to show the regard with which the portal of entry of tetanus was held over a century ago. They seem radical, but the main principle is accepted today as conservative, and by this we mean the proper care of the wound.

The majority of cases are admitted to this hospital after having received home treatment consisting of an application of leafy dirt and carabao manure. In such cases it is imperative to abolish a fertile field for the development of tetanus bacilli. Therefore, study of the Guam cases of tetanus, a few personal observations, and review of the literature make it appear mandatory that a definite routine be employed both prophylactically and therapeutically.

LOCAL TREATMENT.—(1) Every penetrating wound should be incised and converted into an open wound.

(2) Debridement: excision of all devitalized tissue in and about the wound, and removal of all foreign particles.

(3) Sterilization of the wound by: (a) Tincture of iodine applied thoroughly in and about the wound and flushed out with an excess of alcohol after a few minutes' interval. MacConkey and Silva [7] have shown that mixing iodine with the toxin of tetanus bacilli decreases the strength of the toxin. (b) Powerful oxidizing agents in suitable

[7] MacConkey and Silva: Tetanus, Brit. Med. Jour., 1: 411, 1916.

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dilution, such as hydrogen peroxide, sodium perborate, and potassium permanganate in 1:3,000 solution, all used preferably in hot solution. In using these oxygen-liberating drugs the wound must be opened in order that the effervescent gas which is given off does not force septic material into the surrounding healthy tissue. Apply these at frequent intervals.

SERUM THERAPY.—Intrathecal, intravenous, intramuscular, and subcutaneous injections of the antitetanic serum have in various combinations been used at this hospital. The most desirable and efficacious route of administration of serum still remains controversial. However, those cases of this series that received large amounts of serum about the wound showed a much lower mortality rate.

The amounts of serum advocated here are administered as follows during the first 24 hours of treatment:

(1) Locally about the wound and in proximal tissues—20,000 American units.

(2) Intrathecally, second lumbar interspace—20,000 U.

(3) Intramuscularly—20,000 U.

(4) Intravenously—20,000 U, in conjunction with other treatments regardless of the severity of symptoms, and this same dose repeated within 12 hours.

The intrathecal doses of serum are injected undiluted after approximately 20 cc. of spinal fluid have been withdrawn. The intravenous injections are diluted with equal amounts of sterile physiological saline, and this mixture, without previous heating and at room temperature, is allowed to flow into a vein slowly, the total time for injecting being not less than 10 minutes. Injections are continued via all routes in varying amounts as deemed necessary, usually 3 days sufficing for the total amount of serum for any one case.

Prior to administration of antitetanic serum an intradermal wheal test should be made to detect the presence of hypersensitivity to horse-serum. If the patient is found hypersensitive, immediate steps to effect rapid desensitization are taken. These reactions are largely controllable by hypodermic injections of 1 cc. of 1:1,000 adrenalin as necessary, calcium lactate by mouth in 10-grain doses three times a day, and magnesium sulphate in large doses. Serum sickness occurred at this hospital in about 50 percent of cases which received serum over a period exceeding 1 week. It cannot be too urgently stressed that there is no use in apportioning serum therapy over a period of several days. Whatever total dosage is anticipated for the treatment of any single tetanus case should be given in its entirety within 3, or preferably, 2 days. The merit of this is mainly twofold. First, it largely eliminates the possibility of hypersensitive state developing before treatment is completed, and secondly, it assures a maximum concentration of serum sufficient quantitatively to neutralize all toxins present.

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MAGNESIUM SULPHATE.—Beckman [8] writes:

For surely no physician who has once seen the remarkable relaxing power of this salt upon an agonized tetanus patient can seriously doubt its value even though it be not in itself curative.

Properly employed, the results are the very essence of satisfaction to the physician and of gratitude of the patient. Beckman [8] offers the following dosages and methods of administration:

(1) SUBCUTANEOUS.—1.2 to 2.0 cc. of a 25 percent aqueous solution of magnesium sulphate for each 20 pounds of body weight, given four times in 24 hours. This should be continued until disappearance of symptoms. This is less dangerous than the other methods.

(2) INTRAMUSCULAR.—To be used only in severe spasms, as the drug is more dangerous thus, due to the possibility of respiratory arrest. Lightly anesthetize patient with ether and deposit intramuscularly 2.0 cc. of a 25 percent aqueous solution for each 20 pounds of body weight. The effect from this route presents itself in less than ½ hour and disappears after 2 to 3 hours.

(3) INTRAVENOUS.—Most prompt but fleeting results are obtained by this route. The effect may disappear in 30 minutes. This is the most dangerous method of administration. The dose is a 6 percent aqueous solution given very cautiously at the rate of not over 2 to 3 cc. per minute until relaxation begins.

(4) INTRASPINAL.—Effect is secured in less than ½ hour and relief lasts from 12 to 30 hours. Anesthetize the patient with ether and inject 1.0 cc. of a 25 percent aqueous solution for each 20 pounds of body weight into the spinal fluid at the second lumbar interspace, after withdrawal of equal amount of spinal fluid.

For the second dose, 0.8 cc. of 25 percent aqueous solution of magnesium sulphate for each 20 pounds of body weight are given, possibly after 12 to 24 hours as required. Only 0.5 cc. of the 25 percent aqueous solution per 20 pounds of body weight is administered for the third dose.

To combat excessive depression of the respiration by magnesium sulphate, inject 2.5 cc. of calcium chloride in physiological saline intravenously (slowly). The antidotal effect is seen almost at once.

We have used all these methods of administration in the manner recommended by Beckman, except the intravenous method, which we have not used at all because of its danger and for the reason that injection by other routes has been very efficacious.

SEDATION.—A tetanus case is inadequately treated unless, throughout his illness, perfect relaxation of the vast muscle groups is obtained by magnesium sulphate, and mental calm is completely assured at all times by the unstinting but judicious administration of sedatives. Tetanus patients have great fear and apprehensiveness and many foresee impending doom, clearly and painfully conscious of its insidious yet progressive agony up to the last few breaths of life. Few diseases are marked by such mental anguish and unlimited physical suffering from the relentless, exhausting, widespread spasms. Hydrophobia does not excel it in these respects.

Consequently, whatever sedative is selected by the physician from the vast array of available ones, there must be kept uppermost in his

[8] Beckman, H.: Treatment in General Practice, 2d Ed., pp. 226, W. B. Saunders Co., Phila., 1935.

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mind a guiding principle laid down many years ago by Cullen, namely, that sedation perfectly sufficient for the insomnias and restless states of psychoneurotics, injury cases and painful cachectic states will not leave the tetanus case with any but a paltry relief. Then, sedation must be pushed until the patient sleeps practically the entire time. There is no need for him to be awake, for we may avoid aspiration pneumonia or lung abscess by refraining from forcing liquids down between clenched teeth and amongst pharyngeal or laryngeal spasms. The breathing is vital and it must be regular and easy, as it will be under good sedation. Nourishment may be given by many routes such as proctoclysis, phleboclysis, and hypodermoclysis. In the more controllable cases the nasal catheter type of feeding may be safely used if due precautions are kept constantly in mind.

Perhaps the drugs most in use for good sedation are morphine, chloral hydrate, paraldehyde, and the barbiturates. We consider the first two drugs superior, and prefer chloral hydrate to all of them. According to Fantus,[9] chloral hydrate enemata of the following type may be advantageously used in the manner indicated:

Chloral hydrate enema

R_x	Chloral hydrate	8. 00 gm.
	Mucilage of acacia	30. 00 cc.
	Water, to make	60. 00 cc.

Mix et label: 15 cc. in 150 cc. of water given slowly by rectum as a retention enema. Give 10 cc. dose after 2 hours if required. After this not oftener than every 4 hours or every 8 hours.

Morphine, without a doubt, is a marvelous drug in tetanus, but it must be remembered that the tolerance for the drug is enormously increased in tetanus. For the first few doses, then, it is well to give one-half grain doses by hypodermic injections every 2 to 4 hours, much as it is employed in the treatment of eclamptic convulsions.

MISCELLANEOUS MEASURES.—We may enumerate a few, such as: absolutely quiet, darkened room with the best of nursing care; sharp limitation of visitors, or best, none at all; adequate fluid, electrolyte and glucose intake in the early stages; avoidance of unnecessarily moving patient or of subjecting him to needless laboratory procedures; and the avoidance of chilling from the drenching sweats so common in these cases.

PROPHYLAXIS OF TETANUS

The value of tetanus antitoxin was definitely demonstrated on a huge scale during the World War. The prophylactic dose of 1,500 American units is now recognized, as a rule, to safely apply. Punctured wounds, lacerated wounds, all large wounds, and self-inflicted abortions should always be given a prophylactic dose, not overlooking,

[9] Fantus, B.: Therapy of the Cook County Hospital, Chicago, Jour. Am. Med. Assc. 102: 2021-2022, 1934.

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of course, that large group of border-line cases from which are received a great number of cases of clinical tetanus. In what geographical location the wound was obtained or in what environment, to be sure, are very important in determining when prophylaxis shall be given, but we doubt its practicality, primarily for the reason that so many cases have been reported in so-called "clean wounds," "wounds not contaminated with street dust or barnyard dirt" and the like. We believe that, as they do in France, an almost tetano-phobic attitude on the part of more physicians would eliminate the petty and practically unscientific attempts to decide from their native senses and from the history of the case whether a wound is bacteriologically clean and free from tetanus spores. That determination certainly cannot be correctly made and is daily placing patients in a dangerous predicament. What a help toxoid would be in this respect, if patients with such wounds had been immunized months previously. Tetanus antitoxin is usually destroyed or eliminated by the human body within 2 weeks, thus making it necessary to repeat the prophylactic dose every 7 to 9 days until all danger has passed in those wounds which are severely lacerated, deep, and infected. It has been proven by Bruce [10] that in many cases which did develop tetanus after prophylactic antitoxin, the incubation period was prolonged, and the course of the disease was less severe.

Here are two warnings concerning the employment of, and false faith in antitetanic serum in prophylaxis which are rarely stressed sufficiently:

(1) Never give tetanus antitoxin even in a 750 U or 1,500 U dose unless it has been ascertained both by interrogating the patient and by the simple intradermal wheal sensitivity test that freedom from reactions is present. To disregard this procedure is nothing short of malpractice which is subject to successful legal prosecution. If failure to heed this fact has not caused many physicians to lose their fortunes it certainly on repeated occasions has caused them extreme anxiety for the lives of their patients.

(2) Like the tendency in all good procedures, the prophylaxis of tetanus has become stereotyped and condensed into the minds of some as a cut-and-dried, hum-drum, automatic affair, the subconscious workings of which considers that 1,500 units by hypo are invincible protection and stops there, that duty is performed and that the patient will never get the lockjaw after such protection. Such a manner of thinking is only a natural outcome of the enormously busy and ever-changing medical world in which we now live where, if short and rapid, practical rules-of-thumb are not utilized in some instances at least, we are lost in the scuffle.

[10] Bruce, David: Tetanus: Analysis of 1,000 Cases. Tr. Soc. Trop. Med. and Hyg. 11: 1, 1917–18.

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Nevertheless, let us mention that 1,500 U of tetanus antitoxin given on the day of injury and repeated in 6 days did not prevent lethal tetanus in one of the cases of the reported series from this hospital, even though tetanic symptoms did not appear until the ninth day after the trauma. The situation was this:

An 8-inch wound by a carabao's horn, laying open Hunter's canal of the thigh, badly ripping and macerating large sections of major thigh muscles, exposing all the large femoral vessels, and treated by patient himself immediately preceding admission to the hospital. Treatment consisted of applying a poultice made of old, wet, rotten leaves and carabao feces.

THERAPY.—Wound was sutured in layers and a rubber-tube drain was placed to the most dependent wound-depths, and 1,500 U of antitetanic serum were given by hypodermic.

CLINICAL COURSE.—Severe infection had developed by the third day, and by the sixth day the entire wound had sloughed open, was of a foul odor and in bad shape. On that day, the sixth, hot, wet boric acid packs were begun and a second injection of 1,500 U of tetanus antitoxin was given. Chloramine of 1 percent strength was substituted for boric acid on the following day, the seventh, on which date the patient had his first tetanic symptom, consisting of inability to open the mouth widely. On the following day he had outspoken signs of generalized tetanus of a severe degree, accompanied by acute spasmodic laryngeal occlusion which left him in a deep cyanosis, necessitating emergency tracheotomy which was phenomenal in its relief of respiratory symptoms. On this same date, the eighth day following his original wound the most intensive antitetanic serum therapy ever accorded any patient we have seen or read about was instituted in conjunction with the gamut of adjunct symptomatic therapy, which included excellent control of the patient with magnesium sulphate, morphine, and nourishment by nasal catheter and dextrose phleboclysis. He died on the eleventh day after admission to the hospital and on the fourth day following beginning of therapeutic tetanus antitoxin, and after a total of 420,000 American units had been given by every route.

COMMENT.—The World War produced thousands of wounds of this severity, with much dirt contamination, and certain principles were then laid down, which resulted in much improved prophylaxis. This type of wound laden with dirt, feces, and leaves might prove fatal even if all visible particles are removed. The vast number of microscopic particles and bacteria which are certain to remain even after the most careful debridement and wound-flushing with antiseptics, will lead to production of a large pus-pocket if the wound is not allowed to drain without even the slightest obstruction. Therefore, by way of constructive critique the treatment and prophylaxis of this case might have been along these lines.

(1) The wound is left wide-open without sutures and promptly Dakinized or irrigated at frequent, regular intervals with dilute solutions of powerful oxidizing agents. All of this is to be kept up for days or weeks until a healthy granulating wound results.

(2) 10,000 U of tetanus antitoxin are injected deeply into the thigh in and around the wound on admission, after the intradermal sensitivity test is shown to be negative.

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(3) 10,000 U of tetanus antitoxin are injected intramuscularly into the thigh proximal to the wound site, and 10,000 U more in same locality at the end of 6 days.

(4) We might add as a corollary that wounds, which are badly lacerated or in which it is reasonably certain that an overwhelming number of tetanus organisms are present or in the depths of which luxurious anerobic activity thrives, should be treated as local tetanus from the very day of receipt of the wound.

The burden of proof is on the person saying that this manner of handling wounds will not save human lives from the dreaded lockjaw that otherwise would have perished. So, **beware of the 1,500 unit delusion** or even the 3,000 unit delusion, and think of tetanus in terms of quantitative toxin and quantitative antitoxin. These, of course, are best thought of after the elaborating focus of the toxin is rendered inert by timely and correct surgical procedures. To neatly suture a potential tetanus wound is a great temptation and almost irresistible at times. But, it can kill. That was well known before William Cullen's death in 1790. Then let the wound lie open. Develop a tolerance for its sloppy appearance. In the final analysis an actual barter is thereby incurred. A living, grateful patient with a wound scar which possibly is a trifle unsightly is being exchanged for the rare possibility of the surgical scar of primary union and thereby subjecting the patient to the hazard of a probable tetanus infection simply to obtain better cosmetic results.

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CLINICAL NOTES

HYPHERTROPHIC COLITIS [1]

WITH CASE REPORT

By Lieutenant Edward S. Lowe, Medical Corps, United States Navy

Tumorlike inflammatory masses occur throughout the intestinal tract, most frequently in the lower ileum. Isolated involvement of a portion of the colon is unusual, and as this condition with perforation is particularly so, the following case report is submitted.

Due to the more frequent occurrence of this disease process in the lower ileum, it was early known as **terminal ileitis**, later as **regional ileitis**; and then as the process was described in other parts of the intestinal tract, the terms **segmental enteritis, regional enteritis, chronic regional colitis, localized hypertrophic enteritis,** and other similar descriptive names were introduced. We use the term **hypertrophic colitis** as best describing the pathology found in this case.

CASE REPORT

R. A. P.; naval officer; case No. 45950, was admitted to the naval hospital, Canacao, P. I., on August 18, 1937, complaining of pain in the lower abdomen and diarrhoea. Six days previously, patient first felt ill with fever, generalized muscular aching, pain in the lower left abdominal quadrant, and with suddenly developing diarrhoea which progressed to frequent liquid stools in which there was no gross blood. After 3 days the diarrhoea subsided, but the pain in the lower left quadrant persisted, becoming sharp and cramplike periodically. There had been no nausea or vomiting, no chest or urinary complaints, and no previous gastro-intestinal complaints, particularly of a similar nature. The only significant factor in the gastro-intestinal past history was that of an appendectomy 12 years previously with wound drainage for 6 weeks.

PHYSICAL EXAMINATION showed an obese (weight 225 pounds), well-developed American male, age 31 years, appearing ill. Temperature, 101°; pulse, 100; respiration, 22. There were no significant findings except in the abdomen which was obese, showed the presence of a well-healed operative scar in the right lower quadrant, no hernia, and no masses, but spasticity of the lower left rectus muscle, and an area of subjective tenderness in the lower-left quadrant mesially and about 10 cm. below the umbilicus. No mass was palpable by rectum.

LABORATORY.—RBC 5,090,000; Hgb., 100; WBC 14,050; segmented 64, bands 10, lymphs 16, monos 10. Urinalysis was negative. Feces were negative for gross blood, mucus, ova, and parasites and culture was negative for pathological organisms after 72 hours incubation. Kahn was negative. Gastric analysis was normal.

[1] From the U. S. Naval Hospital, Canacao, Philippine Islands.

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X-RAY.—Barium enema August 24, 1937: The barium flows in readily through the rectum, meeting an apparent partial obstruction in the lower sigmoid * * * Conclusions: Inflammatory mass left-lower quadrant producing pressure and inflammation of the sigmoid.

CLINICAL COURSE.—Under hospital care, the temperature curve which was septic in type showed a gradual flattening from 103° on admission to 99° after 2 weeks, at which time, for no apparent reason, the amplitude of the rises of temperature became progressively greater until on the day before operation, September 9, the temperature reached 101.8°. The pulse curve followed the temperature curve. During this time patient had no diarrhoea, but he complained of pain in the lower-left quadrant and on August 25 the attending physician first palpated a definite mass in the lower left quadrant, and confirmed this by palpating a "fullness" on the left by rectal examination. During this period, the white blood counts dropped from a high of 17,500 with 78 percent polys to a low of 9,550 with 61 percent polys on September 2, following which the count rose to 11,800 with 75 percent polys on September 10.

With a mass present in the abdomen, confirmed by x-ray, and the signs, symptoms, and clinical course becoming progressively worse, surgical intervention was decided upon.

The patient went to operation on September 10. A 15 cm. length of the sigmoid was found to be greatly thickened and indurated. In the adjacent mesentery, a mass about 10 cm. in diameter made up of infiltrated infected fat and containing a serious milky fluid was found. Smear was made immediately which showed the presence of a short chain streptococcus. This finding precluded any further operative procedures. Two rubber dam drains were introduced into the abscess and the abdomen was closed. Culture confirmed the presence of the short chain streptococcus infection. Patient developed a generalized streptococcic peritonitis and died 10 days later despite Prontosil therapy, repeated blood transfusions, and intensive postoperative treatment.

AUTOPSY FINDINGS, ABDOMEN.—The small intestine was greatly dilated and was covered with a plastic exudate. Pus was present throughout the abdomen with wells located in the true pelvis and about the sigmoid. Numerous adhesions were present between the different loops of gut and between the gut and anterior abdominal wall. The portion of the sigmoid under the recent surgical incision was greatly thickened for a distance of about 15 cm. Part of this thickened wall appeared gelatinous and in some areas the mucosa appeared very much thickened and elevated in folds. There was no evidence of ulceration in the sigmoidal mucosa, but in the indurated area there was a perforation 0.3 cm. in diameter opening into an abscess cavity about 5 cm. in diameter located in the mesosigmoid. No diverticula were seen, or was a diverticulum present at the site of perforation.

Sections were cut for pathological examination in this hospital, and the remaining gross specimen of the sigmoid was sent to the Navy Medical School, Washington, D. C., for study. Their report which confirmed our microscopic findings is as follows:

Gross examination.—Specimen consists of a section of colon reflected on itself and adherent making a large mass. Cut sections through the mass reveal mostly fat. The walls of the colon, in areas, appear to be gelatinous. In some areas the walls of the colon are thin, and in others, quite thick. Parts of the mucosa are thrown into folds, while other parts are smoothed out.

Microscopical examination.—Sections from 17 different areas of the sigmoid were examined. In some places the mucosa is normal; in other areas the mucosa is thrown into papillary folds and the mucous glands are greater in number than normally seen, with an increased amount of mucoid secretion on the surface. Near the site of the perforation there is a marked hypertrophy of the mucosa which

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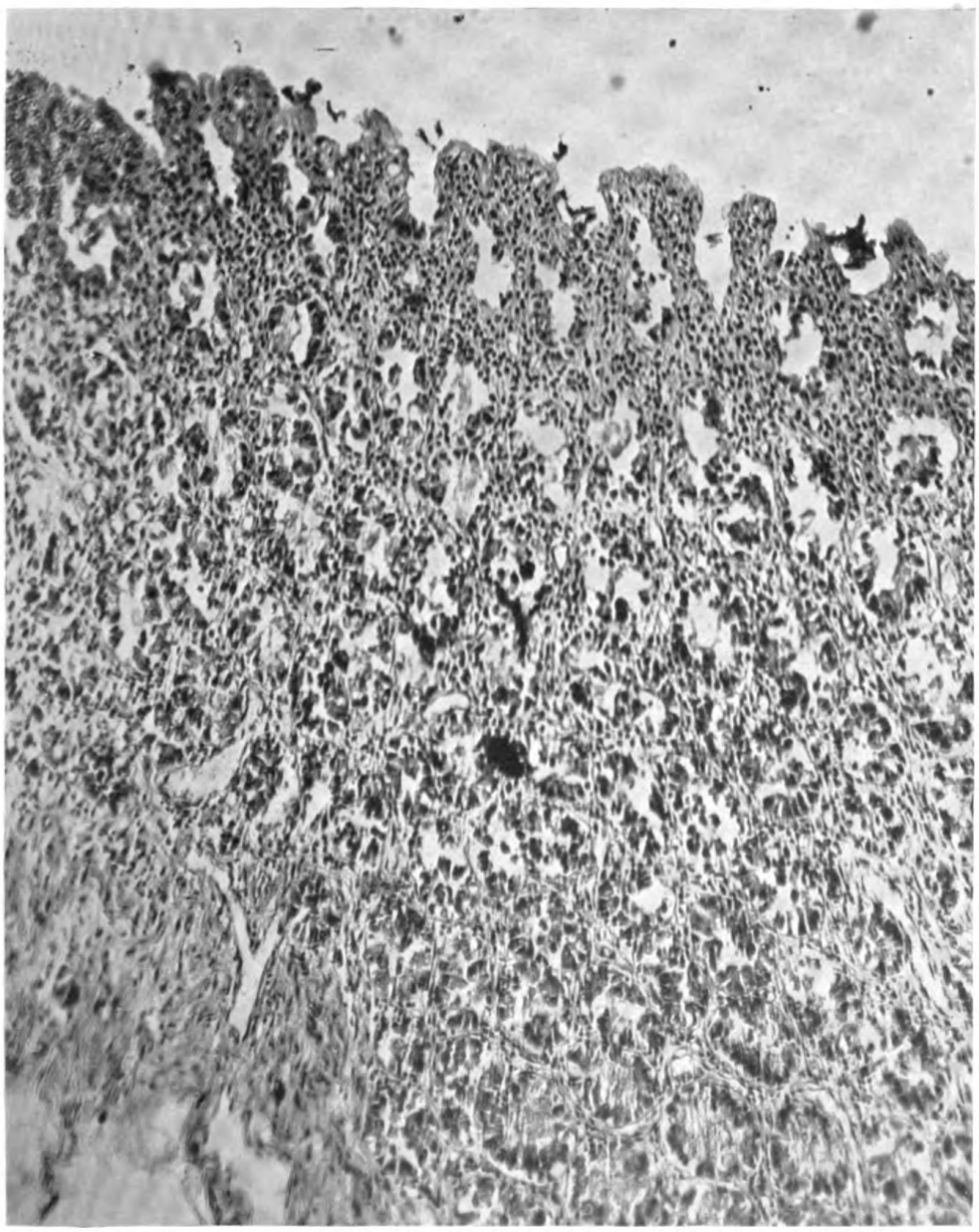


FIGURE 1.—MUCOSA IN HYPERTROPHIC COLITIS.

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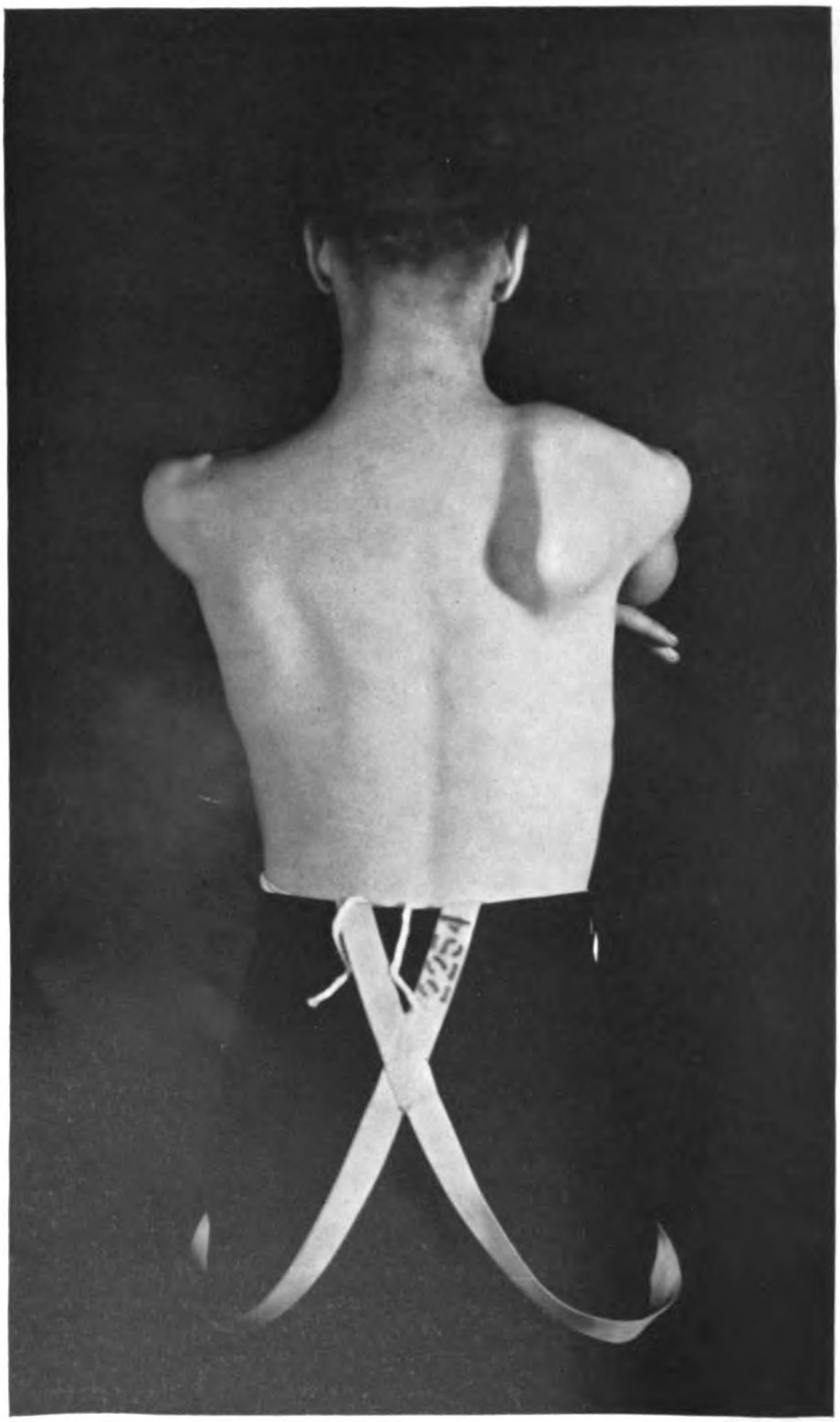


FIGURE 2.—PARALYSIS FOLLOWING ANTITETANIC SERUM.

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is thrown into papillary folds. (See fig. 1.) The epithelium at the site of the perforation is, of course, missing and the fibrous tissue is eroded and infiltrated with pus cells, as is the overlying fat. The peritoneral surface shows a marked inflammatory reaction. There is no evidence of malginancy, tuberculosis, or amoebic infection.

Pathological diagnosis.—Hypertrophic colitis with perforation and peritonitis.

Note.—Sections were sent to Johns Hopkins Department of Pathology and they concurred in the above diagnosis with the following comment: "It is akin to the cases of hypertrophic gastritis with ulceration in histologic appearance, but we have never observed it before in the colon."

The occurrence of this pathological process in the left colon must be rare; in fact Lick [2] in his article on "Regional Ileitis" together with an extensive review of the literature, states: "No case has been reported in which the disease involved the left colon or rectum." We wish to make note that the disease process in the case herewith reported did involve the sigmoid and no other part of the gastro-intestinal tract.

James [3] reports a case in which the distal part of the transverse colon and the whole of the descending colon were involved.

Crohn, to whom credit is given for pointing out the clinical and pathological entity of regional ileitis,[4] accedes to the occurrence of this disease in the large intestine, and adds the concept of a combined ileitis and colitis with "skip areas"; i. e., the pathological processes being separated by normal sections of intestines.[5]

Both Crohn and Mixter [6] stress the tendency to the formation of sinuses and fistulas in regional ileitis, and Mixter points out that perforation at the mesenteric attachment may take place with the formation of a blind sinus or abscess between the leaves of the mesentery. The latter took place in the case reported herein, and, unfortunately for the patient and the surgeon, the invading organism, a short chain streptococcus, was present in the abscess so formed.

PARALYSIS FOLLOWING INJECTION OF ANTITETANIC SERUM

CASE REPORT WITH SERRATUS MAGNUS INVOLVED

By Lieutenant C. R. Ball, Medical Corps, United States Navy

A serum reaction following the injection of an antitoxin is not unusual but a paralysis following the reaction is unusual. Rider [1] states that the possibility of tetanus antitoxin causing a plexus paralysis is extremely rare and had even been denied by authorities, on the basis that none occurred during the war. Recently cases have been

[1] Ridder: Plexus paralysis after tetanus antitoxin, munchen. med. Wchnschr. 81: 1085, 1934.

[2] Lick, M.: Regional ileitis, review of literature and case report, Internat. Abstr. Surg. 66: 340–349, 1938; In Surg., Gynec. & Obst., April 1938.

[3] James, T. G. I.: Chronic regional colitis, Brit. J. Surg., 25: 511, 1938.

[4] Crohn, B. B., Ginzburg, L., and Oppenheimer, G. D. J. Amn. M. Ass., 99: 323, 1932.

[5] Crohn, B. B., Surgery, Gynecology, and Obstetrics, 68: 314, 1939.

[6] Mixter, C. G., Surgery, Gynecology, and Obstetrics, 68: 322, 1939.

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reported by Schelling, Demme, and Lische. The mechanism of such paralysis is obscure. French [2] in his book describes paralysis of the serratus magnus as follows:

In paralysis of the serratus magnus due to injury or neuritis of the long thoracic nerve, the patient may complain of general weakness of the arm and particularly of his inability to raise it in a horizontal position. The trouble arises from the fact that the scapula is no longer held against the thoracic wall and connot be rotated with the movements of the limb. The origin of this disability may be overlooked if the arm only is examined. If, however, the position of the scapula is observed when the arm is moved in different directions, the correct diagnosis can be arrived at. When the arm hangs at rest by the side, the scapula is seen to be slightly raised and displaced outwards, with the inferior angle inclining towards the vertebral column and perhaps somewhat separated from the chest wall. When the inner arm is raised forward to the horizontal position and pressed against some resistance, the inner border of the scapula projects backwards and presents a "winged" appearance. This deformity ought always to suggest paralysis of the serratus magnus.

The following case report of paralysis of the serratus magnus muscle after the injection of antitetanic serum and a brief discussion of the cases collected from the literature are of interest.

CASE REPORT

W. W. B., Midshipman 4th class.

FAMILY HISTORY.—Negative.

PAST HISTORY.—Usual childhood diseases of measles, whooping cough, and chicken pox without complications. Before he entered the Naval Academy he was in the Service, having enlisted in the Navy in December 1934. The only history of exposure to lead that can be obtained was from June to October in 1935, when he was chipping paint below decks. His health at that time was excellent and when admitted to the Academy in July 1936, a year later, he was found to be in excellent physical condition.

PRESENT ILLNESS.—While playing soccer ball on October 2, 1936, he received a lacerated wound of the lower third of his right leg. The injury was caused by a spike in the shoe of an opposing player. An intramuscular injection of 1,500 units of tetanus antitoxin was given in the left posterior shoulder region. The lacerated wound healed without complications.

October 8 he was admitted with the subjective symptoms of headache, pain, and itching in the left shoulder at the site of the tetanus antitoxin injection, and itching of the left arm where a skin test for hypersensitiveness was made. Examination of these areas showed an acute inflammation of the skin and subcutaneous tissues and enlargement of the regional lymph nodes.

October 9, he developed a generalized urticaria and complained of marked weakness and general malaise. There was a stiffness of the muscles of the right arm. He could not flex the right elbow. Radiant heat was applied to the muscles of the arm and shoulder. The stiffness disappeared in several days and the patient then complained of a constant mild pain in his shoulder and arm which gradually disappeared. He was returned to duty and an entry in his health record dated October 16, stated that he was well.

[2] French, Herbert: An Index of Differential Diagnosis of Main Symptoms, 4th ed., William Wood and Co., Baltimore, Md., 1928, pp. 616–617.

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He reported to the dispensary again on December 8, 1936, with the subjective symptoms of difficulty in eating and writing with his right arm because his shoulder blade would strike against the back of his chair when he lifted his arm from his side. He had noticed a gradual weakening of his shoulder and an inability to lift his arm above the horizontal position. He was free from pain. His shoulder tired easily in carrying books to classes. He had some difficulty in the "push-up" exercises in the gymnasium.

PHYSICAL EXAMINATION.—An examination of the right scapula, shoulder and arm follows, as the physical examination was otherwise essentially negative.

Inspection of the patient with his arms at his sides showed a prominence of the right scapula with limitation of abduction of the right arm in that he was unable to lift it above the level of his shoulder. There was an absence of fixation of the scapula and a winging, or protrusion, of the scapula was easily seen with the arms raised to the horizontal position. Palpation showed a marked weakness of forward pushing movements of the arm as well as abduction movements. The reflexes were all present, active and equal. There was no disturbance of sensation noted after careful examination of pain, temperature, etc.

TREATMENT.—Thirty treatments of galvanic and sinusoidal current to the affected muscle were given at the naval hospital, Annapolis, Md., during the months of January, February, and March of 1937. During this course of treatment he was able to continue his studies, drills, and formations. During the treatment there was a gradual improvement of the subjective and objective symptoms. Treatment was discontinued after the last week in March. At that time the strength in his arm had practically returned to normal and he no longer had difficulty in carrying his books, dressing, or in exercising.

He could lift his arm above the horizontal position. The fixation of his scapula was about completed and the winging or protrusion was hardly perceptible. With his arms held at his sides the right scapula was still a little prominent but in its normal position.

He was allowed to make the midshipman's cruise and then went home on leave. Shortly after the beginning of the new academic year in October 1937 he was again examined and found free of subjective and objective symptoms.

DISCUSSION

This case is believed to be due to a paralysis of the muscles supplied by the fifth and sixth cervical roots as a result of the serum given. Trauma does not play a part, as the serum was injected into the opposite side of the back. That this condition was not present previously is rather definite, due to the numerous physical examinations he had in the service. The chief muscle involved is believed to be the serratus magnus, the main action of which is to draw the base of the scapula forward. Along with the trapezius, it tilts the glenoid cavity upwards, facilitating the upward movement of the arm above the head. In this case the patient is unable to raise the arm above the horizontal position. The rhomboideus minor and major supplied by the fifth cervical are believed to be weaker than the left. The prominence of the right scapula shows up well in the picture of the patient (fig. 2) taken before any treatment was started.

Ridder [1] reported the case of a man 48 who received an injury of his foot from a rusty nail and was given tetanus antitoxin in his chest.

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Eight days later he developed a headache, urticaria, etc., which symptoms subsided, leaving him with a paralysis of the right upper plexus with atrophy of the deltoid and infraspinatus muscles. The regression was slow but complete in 2 years without treatment. This was the patient's first injection of serum. An individual predisposition fostered by his occupation, as a cobbler who constantly used his right arm, must be assumed.

Gibson [3] reported the case of a woman of 53 who had never had a previous injection of serum was given antitetanic serum between the shoulders 2 hours after being wounded in the foot by a rusty nail. No symptoms of tetanus developed. Three days after the injection she had severe urticaria followed by multiple neuritis, with sensory, motor, and trophic effects, and was kept in bed for several weeks. The neuritis was most severe about the shoulders. After her acute illness she had paralysis with atrophy of some of the muscles enervated by the fifth and sixth cervical roots, which had completely disappeared 9 months afterward.

Folly [4] reports the case of a man who was injured on the leg by the kick of a horse and given antitetanic serum. Eight days later he developed urticaria and shoulder pains. The pain disappeared from the left shoulder but persisted in the right and was accompanied by weakness of the muscles of the arm and scapula. He concluded that this was a case of neuritis affecting the second, third, and fourth cervical roots to some extent and the fifth cervical root to a greater extent.

Sainton, Descouts, and Leclerc [5] report the case of a mason. Four days after inoculation of antitetanic serum he developed an urticaria and shoulder pains, etc. This was his second injection of serum as he had received a previous one a year before. He was unable to resume his former occupation the following year because of muscular fatigue.

Cot and Pasteur [6] report the case of an urticarial rash and arm and shoulder pains coming on 3 days after inoculation. The pain disappeared on the right side but persisted on the left and was seen 5 weeks after the onset. Examination showed diffuse atrophy of the shoulder muscles. The changes in the reflexes and the results of the electrical reaction eliminated amyotrophies of the myopathic type.

[3] Gibson, E. T.: Brachial plexus paralysis following the use of antitetanic serum. J. Kansas M. Soc., 24: 195, 1924.

[4] Folly: Partial neuritis of the brachial plexus after injection of antitetanic serum. Strasbourg-med. 86: 90, 1928.

[5] Sainton, P., Descouts, P., and Le Clerc, R.: Dissociated paresis of the upper limbs following prophylactic antitetanic sero-therapy, Bull et Mem. Soc. Med. d. Hop. de Paris, 48: 754, 1924.

[6] Cot and Pasteur: Some remarks on the subject of an hemi-parieto-amyotrophic syndrome following prophylactic antitetanic sero-therapy, Bull. et. Mem. Soc. Med. d. Hop. de Paris. 49: 139, 1925.

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Schauwecker [7] injected 2,500 units of tetanus antitoxin into the arm of a 22-year-old male. Six days later urticaria developed with all the typical symptoms. Pain developed in the region of the shoulder blades and sacral region with edema of the larynx and marked hoarseness. The disagnosis of paralysis of the recurrent laryngeal nerve was made by a specialist when patient lost his voice. Two weeks later the voice returned to normal, but weakness in the extremities continued for over 3 months. He adds that paralysis of the brachial plexus has been reported following antitetanic serum as well as from diphtheria antitoxin.

PROGNOSIS

Recovery of these cases with or without treatment has been the rule in from 1 to 2 years.

SUMMARY AND CONCLUSION

A case of paralysis of the serratus magnus following an injection of antitetanic serum is presented. Similar cases taken from the literature attributed to serum injections are included. Excellent results were obtained in the treatment by using galvanic and sinusoidal current to the affected muscle.

[7] Schauwecker, Karl: Serum disease with paralysis of the recurrent laryngeal nerve, after prophylactic injection of tetanus antitoxin, zentralblatt for chirurgie 60: 1411, 1933

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HOSPITAL CORPS

TRAINING IN MEDICAL DEPARTMENT SPECIALTIES

By Commander W. J. C. Agnew, Medical Corps, United States Navy

For some years it has been the policy of the Bureau of Medicine and Surgery to train pharmacists and enlisted members of the Hospital Corps of the Navy in Medical Department specialties and to issue certificates to those who have successfully completed these courses as "technicians" in the different branches.

Medical and dental officers, as well as chief pharmacists and pharmacists, are urgently requested to bring these facts to the attention of personnel they consider desirable candidates for this advanced instruction. The courses open to warrant officers of the Hospital Corps are more advanced and in some instances require from 2 to 3 years to complete. Instruction is in addition to their usual assignments and is furnished at civilian institutions of learning as afternoon or evening courses. It is the policy of this Bureau to assign these pharmacists to duty where such arrangements are possible and when their usual duties are similar in nature to the instruction being undertaken.

The following courses are available for members of the Hospital Corps, and requests for instruction should be addressed to the Bureau of Medicine and Surgery without delay. Assignments will be made as service conditions permit.

The proper form to use in making application for special training courses can be found in Bu. M. & S. circular letter, Serial No. 621, of July 6, 1936.

Officer personnel

Desired personnel	Course	Length of course	Station to which attached during course
Pharmacist	Chemistry	4 years	Naval Medical School, Washington, D. C. Naval Medical Supply Depot, Brooklyn, N. Y. Naval Hospital, Philadelphia.
Do	Pharmacy	3 years	Do.
Do	Roentgenology	9 months	Naval Medical School, Washington, D. C. Naval Medical Supply Depot, Brooklyn, N. Y.
Do	Commissary	5 months	Naval Hospital, Philadelphia, Pa.
Do	Property and accounting.	3 years	Bureau Medicine and Surgery, Washington, D. C. Medical Supply Depot, Brooklyn, N. Y.

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Enlisted personnel

Desired personnel	Course	Length of course	Station to which attached during course
PhM1c, PhM2c, PhM3c.	Aviation medicine	4 months	All naval air stations.
PhM1c, PhM2c, PhM3c.	Clerical procedures	6 months	All naval hospitals.
CPhM, PhM1c, PhM2c.	Commissary	As necessary.	Naval hospitals.
PhM1c, PhM2c	Deep-sea diving for rescue vessels.	6 months	Naval Medical School and Navy Yard, Washington, D. C.
All ratings	Dental technicians, general	4 months	Naval Dental School, Washington, D. C., and larger dental activities.
Do	Dental technicians, prosthetic.	5 months	Naval prosthetic dental activities.
PhM2c, PhM3c	Electrocardiography and basal metabolism.	4 months	Naval Medical School, Washington, D. C., and all naval hospitals.
PhM2c, PhM3c	Embalming	4–5 months	Naval Hospital, New York.
PhM1c, PhM2c, PhM3c, HA1c.	Laboratory	7 months	Naval Medical School, Washington, D. C. Naval Hospitals, San Diego and Norfolk.
All ratings	Medical field tactics	6 weeks to 3 months.	F. M. F. Brigades at Quantico, Va., and San Diego, Calif. 4th Regiment, Shanghai, China.
CPhM, PhM1c, PhM2c.	Photomicrography	6 months	Naval Medical School, Washington, D. C.
All ratings	Operating room	Indefinite	All naval hospitals.
CPhM, PhM1c, PhM2c, (Laboratory technician only).	Physiological methods for diving and chemical warfare research.	4 months	Naval Medical School and navy yard, Washington, D. C.
PhM1c, PhM2c, PhM3c.	Property and accounting	Varies	All naval hospitals.
PhM1c, PhM2c, PhM3c.	Roentgenology	9 months	Naval Medical School, Washington, D. C.
PhM1c, PhM2c, PhM3c.	Pharmacy and chemistry	do....	Do.

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NAVAL RESERVE

PROMOTIONS, FOURTH QUARTER, 1938

Irwin Schilling Brown, 600 Professional Building, Kansas City, Mo., promoted to lieutenant commander, MC–V(S), U. S. N. R., October 12, 1938.

Isadore Zugerman, 6320 Broad Street, Philadelphia, Pa., promoted to lieutenant MC–V(G), U. S. N. R., October 12, 1938.

Frank James Braceland, 111 North 49th Street, Philadelphia, Pa., promoted to lieutenant, MC–V(S), U. S. N. R., December 28, 1938.

RESIGNATIONS, FOURTH QUARTER, 1938

Randolph M. Nock, Professional Building, Lincoln, Nebr., lieutenant, MC–V(S), U. S. N. R., resignation accepted October 11, 1938.

J. E. M. Thomson, 1104 Sharp Building, Lincoln, Nebr., lieutenant commander, MC–V(S), U. S. N. R., resignation accepted October 11, 1938.

William K. Kistler, 1706–07 Aldine Trust Building, 1930 Chestnut Street, Philadelphia, Pa., lieutenant, MC–V(S), U. S. N. R., resignation accepted October 11, 1938.

Charles J. McDevitt, 1013 Carew Tower, 443 Vine Street, Cincinnati, Ohio, lieutenant commander, MC–V(S), U. S. N. R., resignation accepted October 11, 1938.

William D. Stubenbord, 140 East Fifty-fourth Street, New York, N. Y., lieutenant, junior grade, MC–V(S), U. S. N. R., resignation accepted November 16, 1938.

Francis A. Riebel, 15 West Goodale Street, Columbus, Ohio, lieutenant, MC–V(S), U. S. N. R., resignation accepted November 16, 1938.

Joseph E. Jensen, Pahala, Hawaii, lieutenant, MC–V(S), U. S. N. R., resignation accepted November 16, 1938.

William R. Delzell, 945 Lexington Avenue, New York, N. Y., lieutenant commander, MC–V(S), U. S. N. R., resignation accepted November 16, 1938.

Frederick A. Hemsath, Fourteenth and Washington Streets, Wilmington, Delaware, lieutenant, MC–V(S), U. S. N. R., resignation accepted November, 16, 1938.

Lewis C. Pusch, York Hospital, York, Pa., lieutenant, MC–V(S), U. S. N. R., resignation accepted December 8, 1938.

Ralph E. Netzley, 815 Oakwood Place, Pasadena, Calif., lieutenant, MC–V(S), U. S. N. R., resignation accepted December 8, 1938.

C. W. Dowden, 920 Brown Building, Louisville, Ky., lieutenant commander, MC–V(S), U. S. N. R., resignation accepted December 30, 1938.

Lewis H. Bacon, 300 Mahantongo Street, Pottsville, Pa., lieutenant, MC–V(S), U. S. N. R., resignation accepted December 30, 1938.

HONORABLE DISCHARGES, FOURTH QUARTER, 1938

Alfred F. DeMilia, 231 East Putnam Avenue, Greenwich, Conn., lieutenant, junior grade, MC–V(G), U. S. N. R., honorably discharged October 19, 1938.

William Pillsbury Locke, Hyde Park, New York, N. Y., lieutenant, junior grade, MC–V(G), U. S. N. R., honorably discharged December 8, 1938.

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HONORARY RETIRED LIST, FOURTH QUARTER, 1938

John Park Dougall, 947 South Gramercy Drive, Los Angeles, Calif., lieutenant commander, MC–V(S), U. S. N. R., transferred to honorary retired list October 19, 1938.

Roland Hammond, 41 Boylston Avenue, Providence, R. I., lieutenant commander, MC–V(S), U. S. N. R., transferred to honorary retired list December 19, 1938.

DEATH, FOURTH QUARTER, 1938

John R. Hume, New Orleans, La., lieutenant commander, MC–V(S), U. S. N. R., died October 29, 1938.

RESERVE MEDICAL OFFICERS RECOMMENDED FOR PROMOTION

December 23, 1938, the Secretary of the Navy approved the report of the Selection Board to recommend officers of the Medical Corps of the Naval Reserve for promotion to the grades of captain and commander. Commissions of selected officers who are found physically and professionally qualified for promotion will be dated July 1, 1938.

The following officers were recommended for promotion to the grade of commander in the Medical Corps of the Organized Reserve; (MC–O., U. S. N. R.): William Arthur Stoops, Newport, R. I.; Page Oscar Northington, New York, N. Y.; William Lemmon Martin, Marion, Pa.

The following officers were recommended for promotion to the grade of captain in the Medical Corps of the Volunteer Reserve; (MC–V(G) of (S), U. S. N. R.): Egerton Lafayette Crispin, Los Angeles, Calif.; Verne Adams Dodd, Columbus, Ohio; Philip Kingsnorth Gilman, San Francisco, Calif.

The following officers were recommended for promotion to the grade of commander in the Medical Corps of the Volunteer Reserve; (MC–V(G) or (S), U. S. N. R.): John Carroll Ruddock, Los Angeles, Calif.; William Russell Levis, Chester, Pa.; Lawrence Flond Drumm, Utica, N. Y.; Adrenne Albert Stott, Bath, Maine; Robert Ballantine Sweet, Long Beach, Calif.; Robert Travis Canon, Lubbock, Tex.; Waddie Pennington Jackson, Roanoke, Va.; John Theron Short, Fort Wayne, Ind.; James Carlos Ghormley, Portland, Oreg.; John Leonard Lavan, Grand Rapids, Mich.; William Henry Olds, Los Angeles, Calif.; Homer Allen Higgins, Little Rock, Ark.; William E. Costolow, Los Angeles, Calif.; Frank Theodore Maxson, Seattle, Wash.; Harold A. Thompson, San Diego, Calif.; Joseph Sumpter Rhame, Charleston, S. C.; Roy B. Harrison, New Orleans, La.; Lyell Cary Kinney, San Diego, Calif.; Joseph Madison Greer, Phoenix, Ariz.; Julius Louis Waterman, Bradford, Pa.; William Lee Cowles, Shawmut, Ala.; Harold Laurens D. Kirkham, Houston, Tex.; Henry Hunt Searls, San Francisco, Calif.; Warren Douglas Horner, San Francisco, Calif.; Clayton F. Andrews, Ann Arbor, Mich.; Ernest Risley Eaton, New York, N. Y.; Walter Frank Schaller, San Francisco, Calif.; James

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Sybert Klumpp, Huntington, W. Va.; Charles Edward Watts, Seattle, Wash.; Eric Liljencrantz, San Francisco, Calif.; Calvin Barstow Faunce, Boston, Mass.; Thomas Byrd Magath, Rochester, Minn.; Winchell McKendree Craig, Rochester, Minn.; Howard Leighton Updegraff, Los Angeles, Calif.; Waltman Walters, Rochester, Minn.

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NOTES AND COMMENTS

TENTH INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY

The organizing committee of the Tenth International Congress of Military Medicine and Pharmacy which will be held in Washington May 7 to 15, 1939, announces that 35 countries have accepted the invitation of the President of the United States to participate in the congress and that already about one hundred ranking medical officers of the armed forces have been designated as official delegates. The committee, which is responsible for the organization and operation of the congress, functions under the presidency of Maj. Gen. C. R. Reynolds, Surgeon General of the Army, and consists of representative officers of the Army, Navy, Public Health Service, and Veterans' Administration.

Detailed plans for the congress have now been completed and include a New York reception committee, with their office in the Waldorf-Astoria, a special day at the World's Fair, and a scientific and social program that will continue through a whole week in Washington.

Registration is without fee and is open to all medical officers, active or retired, of the armed forces, Public Health Service, and Veterans' Administration.

Information as to the congress will be furnished on request by the Secretary General, Tenth International Congress of Military Medicine and Pharmacy, Army Medical Library, Washington, D. C.

THE SUCCESSFUL PHYSICIAN

Salesmanship is an outstanding characteristic of the successful practitioner, just as it is of the charlatan. The ability to sell ones self to the patient, and the relatives, to create in them confidence in the doctor, may be a natural gift in a few, but most of us must acquire it by conscious effort. The men best known in the Medical Corps of the Navy possessed this quality in unusual measure.

For the general practitioner, salesmanship is a matter of bread and butter. If he does not have it, or cannot cultivate it, he will not prosper. For the naval medical officer, it was not regarded as being so important in the past as it has become since selection was adopted. All of us can recall men of more than average professional ability who failed to advance because they lacked that certain quality of

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salesmanship, personality, or the power of suggestion. Long before the time of Christ, the need for this attribute in the healer was recognized.

Lorenz [1] defines this as "A persuasive impulse that influences more or less powerfully the action, the thinking, or feelings of a person." It may arise from the environment, from words, from actions, from situations, or from within the person. When the suggestion comes by words, the patient is likely to resist the influence, but when it comes from within the doctor, there is no resistance. In fact, it is welcomed, because it appears to be to the interest of the patient. Suggestion is such an important part of what the physician does for his patient, that he must use the utmost care in his general attitude, his words, his emotional reactions and his facial expressions. No detail in his conduct in the presence of his patient should be ignored by the physician. Such care of conduct in dealing with patients, says Lorenz, constitutes the well-known bedside manner. It has real therapeutic value and is genuinely scientific.

This same form of suggestion is responsible for the success of the cults, whose practitioners recognize the value of employing the power of suggestion. They recognize that the symptoms created by suggestion are in the ratio of three to one of those caused by a lesion, and are content to leave the 25 percent to nature if they can relieve the 75 percent which are due to suggestion. The physician often endeavors to cure the 25 percent, for which he can find an organic cause, but neglects the 75 percent, and leaves the patient still dissatisfied, the victim of his imagination.

All this is well known, but is neglected, being overshadowed by our pursuit of the scientific side of medicine. But it is a tremendous factor in the success of the physician, whether he be a civilian practitioner or a medical officer in the Government service. To be successful, it must be practiced on all patients, not just the important ones; on the recruit in the ward as well as on the admirals' wife. Kipling expressed the idea when he said that the things that are learned from the yellow and brown, they help a lot with the white.

Certain medical officers in the Navy possess this quality of salesmanship. Their wards are always quiet, orderly, and cheerful. Their patients are satisfied and confident that they will recover. Relatives of their patients are cooperative and sound the praises of the hospital and the Navy. Commanding and executive officers recognize such doctors as superior, and desire to get them on their staffs. They also give them glowing fitness reports, which aid in selection. This matter of selling himself to his humblest patient is an important one for the service doctor and well worth cultivating.

[1] Lorenz, W. F.: The power of suggestion. Wisconsin Med. Jour., 38: 27, 1939.

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BONE MARROW BIOPSY

During the past decade, with increasing frequency, numerous articles on studies of the sternal bone marrow have appeared in medical literature. These have been called forth by the realization that blood pictures do not always give an accurate idea of the underlying pathological process that exists in the haematopoietic organs of which the bone marrow is chief.

Detailed knowledge of the bone marrow cells is relatively recent, as the first biopsy of the sternum was done by Pianese in 1903. Seyfarth, in 1923, by trephining the sternum was the first to give any worthwhile information on its cellular content. Arinkin, in 1929, reported upon studies obtained by needle aspiration.

Specimens of marrow obtained by trephining probably offer the best material for study, as sections, smears, imprints, and cell suspensions can be made. The relative distribution of the cells as well as the fine cellular morphology are preserved, but this method has the disadvantage of requiring surgical measures.

Aspiration of the sternal marrow is a comparatively simple procedure and can be repeated numerous times on the same patient without too much inconvenience. The apparatus required is simple, a Luer syringe and a shortened spinal puncture needle being all that is necessary, although numerous specially constructed needles are on the market. The myeloid-erythroid ratio, average normal being 2.7:1, differential count and amount of marrow fat can be readily ascertained.

Cultures of the bone marrow cells have been made for study purposes, especially by Maximow, Erdmann, and Osgood. However this method at the present time does not lend itself to clinical work.

Ordinarily, bone marrow studies are not done if the diagnosis can be made by other means, although in some clinics it is becoming almost a routine procedure. There are numerous disorders of the blood forming organs that are baffling as to cause in spite of complete blood studies, and it is in these cases that bone marrow biopsies may render considerable aid, particularly in aplastic anaemias, "aleukemic" leukemia, myelophthisic anaemia and atypical thrombocytopenic purpura, malignant neutropenia and certain of the macrocytic anaemia. In the treatment of severe cases of pernicious anaemia the effectiveness of liver preparations can be checked, as changes in the marrow may be detected some days before changes are seen in the blood.

In some cases accurate studies of the marrow from the sternum, femur and tibia should be checked, but the patient would in all probability object. Much research work is yet to be done in order to correlate the findings in the marrow and peripheral blood of many of the dyscrasias to give a more thorough understanding of their origin, now so little understood.

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Custer, Dameshek, Doan, Downey, Young, and Osgood and many others have contributed considerable to the literature on the subject. A short review, with a comprehensive list of references, of the diagnostic value, including technics, of sternal marrow aspirations by Louis R. Limarzi, M. D., appears in the Illinois Medical Journal of January 1939.

EMULSIONS[1]

The reference article is of timely interest to members of the Hospital Corps.

The author, Chief Pharmacist Paul T. Rees, United States Navy, while a graduate student at the George Washington School of Pharmacy, Washington, D. C., conducted a series of experiments over an extended period of the various methods employed in pharmacy for preparing emulsions.

Mr. Rees found that there are four methods in general use for preparing the oil in water (O/W) type of emulsion: (*a*) trituration in a mortar; (*b*) agitating in a milk-shaker mixer; (*c*) stirring in a mechanical mixer, and (*d*) the use of the Homogenizer.

As the result of these experiments, the author found that from the viewpoint of time of manufacture and stability of the finished product, the Homogenizer produced the best emulsion, requiring but 8 minutes. The Mix-Master required 8 minutes for manufacture, producing an emulsion satisfactory for immediate use, but showing stratification in the course of 1 week. The mortar emulsion required 16 minutes for manufacture and produced a satisfactory product for immediate use, but showing stratification after 1 week storage. The milk-shaker proved unsatisfactory in that no emulsion was formed after 16 minutes of agitation.

The author concludes his discussion of the subject by recommending the Homogenizer as the best utensil for manufacturing palatable and stable emulsions. The Mix-Master was second and the mortar-and-pestle third choice.

The reviewer concurs in the recommendation of the Commanding Officer of the Naval Medical Supply Depot, New York, N. Y., that a hand-operated Homogenizer of 12 ounces capacity be placed on the supplementary supply table for use at the naval hospitals and the larger units afloat.

It is suggested that members of the Hospital Corps read the reference article for the various theories advanced regarding the behavior of the different phases in the formation of the emulsion nucleus. The discussion is interesting but beyond the scope of this review.

[1] Rees, P. T.: A study of emulsions, J. Amer. Pharm. Assoc., 27: No. 7, 1938.

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SYMPOSIUM ON VIRUS AND RICKETTSIAL DISEASES

The faculty of the Harvard School of Public Health offers a short course of lectures, clinics, and demonstrations on the virus and rickettsial diseases, with special emphasis on their public health significance, to be held at the school during the week of June 12–17, 1939. Lectures on the etiology, epidemiology, and methods of control of these diseases, given by members of the faculties and by former students of the Harvard School of Public Health and of the Harvard Medical School, will occupy five mornings. Special clinics and demonstrations will be given each afternoon. In some instances these demonstrations will be continued through the week, so that all the members of the symposium can attend. On the last morning, a panel discussion will be held on the three main topics presented in the symposium.

The fee for the course will be $25, payable at any time up to June 12. Enrollment, however, should be arranged before June 1, as facilities for many of the clinics and demonstrations are limited.

The lectures will be published later in a single volume, which will be sent to each person who has registered for the course. The address of the secretary of the school is 55 Shattuck Street, Boston, Mass.

The Bureau of Medicine and Surgery will welcome requests of applicants to attend this symposium. It is not practicable for the Bureau of Navigation to issue orders for this temporary duty. Official authorization to attend should be obtained from the applicant's commanding officer. Applications received prior to May 1, will be referred to the Post Graduate Board for recommendation as to official nomination for enrollment and payment of fee from public funds, if available.

NEW MEMBERS, AMERICAN COLLEGE OF SURGEONS

The Bureau of Medicine and Surgery has been informed that the following naval medical officers have been elected to Fellowship in the American College of Surgeons.

Lieut. Comdr. Robert E. Baker, (MC), U. S. N.; Lieut. Herman A. Gross, (MC), U. S. N.; Lieut. Fred Harbert, (MC), U. S. N.; Comdr. Hardy V. Hughens, (MC), U. S. N.; and Lieut. Frank P. Kreuz, Jr., (MC), U. S. N.

SULFANILAMIDE

The clinical use of this and related drugs has been attended by acute toxic reactions, usually of a minor nature, occasionally severe, and apparently completely reversible except in the occasional fatal case. It has been apparent, both experimentally and clinically that individual and species differences in tolerance exist. In a recent study

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of some of the toxic effects of sulfanilamide and sulfanilyl sulfanilamide (disulfanilamide), in chickens and rabbits, Rosenthal [3] has presented evidence of cumulative and of delayed toxic reactions. He points out that this had previously been demonstrated for guinea pigs but apparently does not occur in dogs, rats, or mice.

The results obtained in these experiments depended upon large dosage (0.5–2 gms/kilo), far in excess of any used clinically. However, cumulative toxicity does occur in humans with dosage of approximately 0.066 gms/kilo (5 gms daily for 75 kilo or 165 lb. individual) and there are clinical reports suggestive of delayed toxic reactions in humans.

The histopathological studies on these animals are therefore of interest. They demonstrate [4] the general nature of the toxic reaction to fatal or near fatal doses of these compounds and suggest the potential effect of lesser dosage in the occasional intolerant individual. There were rather uniform fatty changes in the liver, splenic, and hepatic (chiefly Kuppfer cell) hemosiderosis, degenerative renal tubular changes, bone marrow hypo- and hyper-plasia, peripheral neuritis, degenerative testicular changes, focal pneumonitis, and occasional lesions in the heart and voluntary muscles.

In the clinical use of these drugs it is well to remember that a blood level of 10 mg. percent of sulfanilamide is usually adequate and can be reached by giving 4 grams daily. A lesser amount will frequently suffice and as a rule only in the acute and dangerously ill patients are blood levels up to 15 mg. percent required. As the infection subsides a reduced dosage can be continued as needed to prevent relapse. The patients with anemia tolerate the drug less well and reduced renal function tends to cumulation. With the appearance of the more serious evidences of toxicity, the further administration of sulfanilamide may not be contraindicated, but one should proceed with care. The patient must be seen daily; and fever, a "measly" rash, falling hemoglobin, or leukopenia, may be regarded as danger signals. Above all, intelligent supervision by a physician is essential.

"STATE MEDICINE, NAVY STYLE"

The following quoted letter is the response of a friend of the Navy, addressed to the editor who published the titled article. This letter is self explanatory. This Bureau regards such publicity as subversive propaganda rather than as a controversial issue involving the professional merit of the service. The service provides ample opportunity for correction of abuses and protection of individual rights and privileges. Obviously the publicity given this issue was neither in conformity with service tradition, nor so directed as to benefit the service. The Bureau welcomes this opportunity to reassure person-

[3] Rosenthal, Sanford M.: Public Health Reports, 54: 95 (Jan. 27) 1939.
[4] Nelson, A. A.: Public Health Reports, 54: 105 (Jan. 27) 1939.

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nel of the Navy Medical Department that it has full confidence in their ability and faithful performance of duty. The publication in question is accorded the same anonymity that the author employed so expeditiously.

PHILADELPHIA, PA., *February 11, 1939.*

DEAR SIR: As a physician, until recently in the active practice of medicine and intimately associated with recognized affiliates of organized medicine, I cannot let pass without criticism the gross distortions and misstatements incorporated in the article, "State Medicine, Navy Style," in your issue of January 1939.

It has been my privilege, occasioned by a severe illness, to be a patient for 4 months in the United States Naval Hospital, Philadelphia. While there I have been able to observe at first hand the unequaled physical equipment of a thoroughly up-to-the-minute hospital; its medical and surgical personnel is unsurpassed by any of the many civilian institutions with which I am familiar.

Your description of the modus operandi of any naval hospital is both ridiculous and ludicrous. If there is anywhere a more capable, conscientious, harder working, well-trained group of physicians and surgeons than those splendid men in the naval hospital, I do not know them. The men I have come to know need not take off their figurative hats to anyone. I am not surprised that the author of your story hides under the cloak of anonymity.

Very truly yours,

J. ALLAN BERTOLET, M. D.

NEED FOR FLIGHT SURGEONS

With the progressive expansion of the naval air forces, the need for additional flight surgeons has likewise increased. The need for medical officers trained in this specialty will continue to increase with the establishment of proposed additional air bases.

In view of the increasing importance of aviation as an arm of the naval forces, the importance of aviation medicine as a specialty cannot be overly emphasized. In this regard, it may be pointed out that this specialty has been duly recognized officially by the Bureau of Medicine and Surgery, the Bureau of Aeronautics, and the Bureau of Navigation. The scope of training in this specialty has recently been extended by this Bureau, to include special training at Pensacola. It is the desire of the Bureau to train, not only sufficient flight surgeons to meet the requirements of the air forces, but also to provide a surplus, sufficient to permit rotation of duty of all flight surgeons at a naval hospital, for the purpose of experience and training in the field of clinical medicine.

The next class in aviation medicine is scheduled to begin at Randolph Field, Tex., on July 15, 1939. The Bureau will be glad to receive applications for this course. Officers applying for this instruction should be of the rank of lieutenant commander, or below, and should submit their requests as early as possible. Additional information relating to this specialty will be furnished on request.

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BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review)

GENERAL BACTERIOLOGY, by *Edwin O. Jordan, Ph. D., Late Andrew McLeish Distinguished Service Professor of Bacteriology in the University of Chicago.* Revised by *William Burrows, Ph. D., Assistant Professor of Bacteriology in the University of Chicago.* Twelfth edition. 808 pages. W. B. Saunders Co., Philadelphia and London. 1938. Price $6.

Thirty years ago, the first edition of this well known medical school text was published.

This new book has its good points as had all the previous editions; but, one comes to the conclusion upon making a careful study of its contents and comparing it with those earlier editions, including the first, that a more complete revision with appropriate deletions, more extensive rewriting and needed additions could have been effected.

The publisher does a good job of printing and binding.

A TEXTBOOK OF MEDICAL BACTERIOLOGY, by *David L. Belding, M. D., Professor of Bacteriology and Experimental Pathology, Boston University School of Medicine, Boston, Mass.*, and *Alice T. Marston, Ph. D., Assistant Professor of Bacteriology and Immunology, Boston University School of Medicine, Boston, Mass.*, in collaboration with the following members of the Department of Bacteriology, Public Health, and Preventive Medicine of Boston University School of Medicine: *Sanford B. Hooker, M. D., Professor of Immunology, Sidney C. Dalrymple, M. D., Dip. Bact. (London), Associate Professor of Bacteriology, José P. Bill, M. D., Dr. P. H., Assistant Professor of Public Health and Preventive Medicine,* and *Matthew A. Derow, M. D., Instructor in Bacteriology and Immunology.* First edition, 592 pages. D. Appleton-Century Co., New York and London. 1938. Price $5.

For the past few years, there has been a growing need for a revision in the style and in the amount of material presented to the medical student in the very important basic subject of bacteriology.

This need has been admirably achieved by the authors in this textbook and they furthermore well fulfill their aims as set forth in the preface.

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The general practising physician will find this a useful addition to his library.

Nonglare off-white paper with good printing add extra value to the book.

PRACTICAL MICROBIOLOGY AND PUBLIC HEALTH, by *William Barnard Sharp, S. M., M. D., Ph. D., Professor of Bacteriology and Preventive Medicine in the Medical Department of the University of Texas; Visiting Bacteriologist of John Sealy Hospital, Galveston; Supervisory Bacteriologist of Galveston Health Department.* First edition, 492 pages, 125 illustrations. The C. V. Mosby Co., St. Louis, Mo., 1938. Price $4.50.

The author has endeavored to discuss under a single cover the field of public health and all of its allied sciences. The book is short, easy to read and well presented to accomplish its purpose.

Primarily the book is for medical students, and for that group it undoubtedly will give a valuable cursory view of the scope of a public health officer, but, for the individual that has received formal training in public health, the book is of little value.

ESSENTIALS OF PATHOLOGY, by *Lawrence W. Smith, M. D., Professor of Pathology, Temple University School of Medicine; Formerly Assistant Professor of Pathology, Harvard Medical College; and Associate Professor of Pathology, Cornell University Medical School,* and by *Edwin S. Gault, M. D., Associate Professor of Temple University Medical School.* First edition, 886 pages, illustrated. D. Appleton-Century Co., New York and London, 1938. Price $9.

Upon first seeing this book one is impressed by its size. Its overall measurements are 9⅛ by 11¼ inches with a page size of 8½ by 11 inches. This size page lends itself nicely for illustrations, but makes the book too large for the average bookshelf. The number of subjects discussed certainly seem enough to cover the essentials of pathology. There are 295 case histories given to exemplify the various pathological processes; but it gives the impression that one is getting a volume of case histories rather than one dealing with fundamental pathological processes. It will be interesting to note if the uninitiated sophomore medical student, using this book as a text, does not sacrifice sound fundamental knowledge of pathology to a more or less superficial one in clinical pathology.

The book contains many fine illustrations in black and white as well as a number in color. Of the 886 numbered pages 101 are left blank for the recording of notes. They will probably continue to serve only as a filler. The binding, paper, and printing are excellent.

This book will be of value as a reference for the student during his clinical years and after he has graduated, and, as such, is highly recommended. However, it is not believed that this book will serve the beginner in pathology as well as any one of several other texts.

THE PRINCIPLES AND PRACTICE OF MEDICINE, originally written by *the late Sir William Osler, Bart., M. D., F. R. C. P., F. R. S., Formerly Regius Professor of Medicine, Oxford University; Professor of Medicine, Johns Hopkins University, Baltimore; Professor of the Institute of Medicine, McGill University; Professor of*

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Clinical Medicine in the University of Pennsylvania; Revised by *Henry A. Christian, M. D., LL. D., S. D., F. R. C. P., Hersey Professor of the Theory and Practice of Physic, Harvard University; Physician In Chief, Peter Bent Brigham Hospital, Boston.* Thirteenth edition. D. Appleton-Century Co., New York and London. Price $9.

Osler's Principles and Practice of Medicine is too well known to require an introduction to the readers of the Bulletin.

In this, the thirteenth edition, Dr. Christian has credibly followed his teacher, Sir William Osler, and his colleague, Dr. McCrae, who revised the ninth, tenth, eleventh, and twelfth editions, in continuing the medical traditions of this work.

In an attempt to bring the book abreast of the times it has been necessary to rearrange, rewrite, and add considerable new material.

It is interesting to note in the preface to this monumental task that Dr. Christian states "in preparing this revision, wisely or unwisely, I have had the assistance or criticism of no one."

This text should continue to serve the profession as a familiar and reliable source of valuable information. However, reliance should not be placed solely on this text for the latest information in all fields of internal medicine.

DISEASES OF THE CHEST AND THE PRINCIPLES OF PHYSICAL DIAGNOSIS, by *George W. Norris, A. B., M. D., Formerly Professor of Clinical Medicine in the University of Pennsylvania; chief of Medical Service "A," Pennsylvania Hospital; Erstwhile Colonel, M. C., U. S. Army;* and *H. R. M. Landis, A. M., M. D., Sc. D., Formerly Professor of Clinical Medicine in the University of Pennsylvania.* Sixth edition, Revised. W. B. Saunders Co., Philadelphia and London. 1938. Price $10.

In the revision of this well known text, Dr. Simon S. Leopold completed that part of the work interrupted by the lamented death of Dr. Landis.

Dr. Thomas M. McMillan has thoroughly revised the chapter on electrocardiography and cardiac arrhythmias, previously contributed by Dr. Edward B. Krumbhaar.

Likewise of interest to readers of the Bulletin, Dr. Louis H. Clerf contributed the section on diagnostic bronchoscopy in diseases of the bronchi and lungs.

The book has been brought abreast the times by many deletions, substitutions, additions, and by the rewriting of many sections, notably those dealing with bronchial asthma, bronchiectasis, lung abscess and the relations of nasal and accessory sinus disease to infections of the lower respiratory tract.

As in the previous editions, the entire text is instructively illustrated.

It should continue to serve the profession as a standard authoritative source of information.

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DISEASES OF THE EAR, NOSE AND THROAT, by *Francis L. Lederer, B. Sc., M. D., F. A. C. S. Professor and head of the department of Laryngology, Rhinology and Otology, University of Illinois College of Medicine, Chicago; Chief of the Oto-laryngological Service, Research and Educational Hospital.* Illustrated with nearly 500 halftone and line engravings, mostly original, and 16 full-page color plates. F. A. Davis Co., Philadelphia, 1938. Price $10.

This text presents a double format, which materially aids reading. The colored illustrations are excellent and the schematic representation of anatomic structures with insert diagrams of histological anatomy is an innovation in this text book, which certainly is worthy of ones attention. The diagrams facilitate an appreciation of physiologic and pathologic states.

This book is composed of five sections. Section one deals with diseases of the ear. Section two describes diseases of the nose and sinuses. Section three is concerned with diseases of the pharynx. Section four is devoted to diseases of the larynx, trachea, bronchi and esophagus. Section five discusses correlated conditions such as allergy, neck enlargements, disorders of speech and a chapter devoted to legal medicine. This chapter includes valuable information for any practitioner of medicine.

In the first four sections the first chapter is devoted to anatomy of the part discussed and is as comprehensive as any of the standard texts of anatomy. The teachings of Alexander, Beck, Hajeck, Neumann, Pierce and others have influenced the presentation of fundamentals of the diseases of the upper air and food passages.

Sections devoted to operative treatment are not as comprehensive as sections on diagnosis and the otolaryngologist might prefer a text with a more extensive discourse for operative technique. In spite of this the text is a good one and because of its very excellent and systematic arrangement is apt to become a standard text for ear, nose and throat diseases in many of our medical schools. It is a text which would be a valuable adjunct to the medical officer ashore and afloat.

THE PRINCIPLES AND PRACTICE OF PERIMETRY, by *Luther C. Peter, A. M., M. D., Sc. D., LLD., F. A. C. S. Professor of Opthalmology in the Graduate School of Medicine of the University of Pennsylvania, Philadelphia; Ophthalmologist to the Graduate Hospital of the University of Pennsylvania; Consulting Ophthalmologist to the Rush Hospital for Consumption and Allied Diseases, Philadelphia, Pennsylvania, etc.* Fourth edition, thoroughly revised, octavo, 331 pages, illustrated with 222 engravings and 5 colored plates. Lea & Febiger, Philadelphia, Pa., 1938. Price, cloth, $4.50 net.

In this fourth edition, the author gives to students of ophthalmology, a very exacting knowledge of the normal and abnormal visual fields.

He first takes up the anatomy and physiology of visual pathways, explaining the factors which may influence the size and shape of normal fields, then the pathological variations.

The methods, the general technique of field taking, the descriptions of various types of instruments and comparative merits of each are

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outlined. The anatomic or physiologic method of recording fields is compared to our present technique of field projection on the perimeter or Campmeter and reasons given for its superiority.

Under special pathology the author begins with lesions in the intra-ocular portion of the visual pathway and proceeds step by step through each portion of the pathway to, and including lesions of the cortical visual centers. Field changes, important regional anatomical landmarks, tables of differential diagnosis and pathological lesions characteristic of each portion are shown.

The chapter on accessory sinus disease is exceptionally well written. The anatomical relations of the visual pathways to the accessory sinuses, mechanism of involvement of the various portions, and the fine illustrations accompanying the description assist in making a differential diagnosis between sinus disease involvement and other pathological lesions of the visual pathway.

MODERN SURGICAL TECHNIC, by *Max Thorek, M. D., K. L. H. (France); K. C. (Italy), Professor Clinical Surgery, Cook County Graduate School of Medicine; Attending Surgeon, Cook County Hospital; Surgeon-in-chief, the American Hospital; etc.* With a foreword by *Donald C. Balfour, M. B., M. D. (Tor.), F. A. C. S., F. R. A. C. S., Head of Section in Division of Surgery, The Mayo Clinic; Director and Professor of Surgery, the Mayo Foundation, etc.* (Three Volumes. 2045 pages. 2174 illustrations.) Price $30. J. B. Lippincott Co., Philadelphia. 1938.

One's first impression, on looking at this set of books, is a glow of admiration for the enormous energy of the man who could collect so much material, prepare the second edition of his work on Surgical Errors and Safeguards, and at the same time carry on his practice and his teaching activities. As a sober second thought comes the query, is it wise for one man to attempt to cover all phases of surgery without collaboration? Looking carefully through these three volumes, for an answer, the conviction is reached that it is too much for one man to attempt. No one man can be equally skilled in all aspects of the great field of surgery. There must be phases which interest him less than others, and about which he does not know all. To the practised eye, there are very definite indications in his work that Dr. Thorek has special interest in certain branches, and others suffer by comparison.

In rhinoplasty for instance, the methods described and pictured are those of Dieffenbach (1795–1847), Nélaton (1807–73) and Tagliacozzi (*circa* 1600), while the work of Gillies, Ivy, Blair, Ferris Smith and other moderns is ignored. Other defects could be cited, but to do so would create a false impression, for the virtues of the work far outmeasure its defects.

A physician of Dr. Thorek's personality and great experience will always have strong opinions on many subjects, and they are always important, no matter how violently we may disagree with them.

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It is interesting to note that he roundly condemns the use of the McBurney incision, and that he continues to bury the stump of the appendix. However, he is tolerant of the ideas of others. There is no suggestion of dogmatic insistence that there is but one technic that is good, while all others are wrong.

One can summarize by saying that the work is most complete and authoritative, an excellent reference encyclopedia of surgical technic, done in the very best Lippincott manner, and marked by the defects that are inherent in a one-man opus.

FRACTURES OF THE JAWS, by *Robert H. Ivy, M. D., D. D. S., F. A. C. S., Professor of Maxillo-Facial Surgery, School of Medicine and Graduate School of Medicine, and School of Dentistry, University of Pennsylvania* and *Lawrence Curtis, A. B., M. D., D. D. S., F. A. C. S., Assistant Professor of Maxillo-Facial Surgery, Graduate School of Medicine, and School of Dentistry, University of Pennsylvania.* 189 pages; 199 engravings, Revised second edition. Lea & Febiger, Philadelphia, 1938. Price $4.50.

The subject matter is well arranged, commencing with a succinct review of maxillo-facial anatomy, logically progressing to general considerations of jaw fractures, and then to a more specific exposition dealing with various types of fractures of the mandible and maxillae.

This revised edition is essentially the same as the original printing of 1931. The revision presents a brief consideration of fractures of the nasal bones, with a change in the text in regard to the treatment of fractures of the malar bones and zygomatic arches. The description of Robert's technique for malar reduction has been deleted from the newer work, the authors lauding the extra-oral method of Gillies for this procedure. Twenty-two additional engravings are included in the revision.

The last two chapters, "Roentgenographic Technique" by LeRoy Ennis, D. D. S., and "Dietary Management of Jaw Fracture Cases" by Clyde W. Scogin, D. D. S., appear with no change from that as set down in the original 1931 edition.

This book fills an important niche in the field of dental and medical literature. A clear picture of the basic fundamentals of maxillo-facial fractures, consistent with good treatment, is provided. Doubtless, the authors anticipate the use of variations in procedure compatible with the requirements of the specific case being treated. The subject of fractured jaws is adequately covered, without verbosity, making this a treatise especially suitable as a handbook for ready reference.

SURGICAL PATHOLOGY OF THE MOUTH AND JAWS, by *Arthur E. Hertzler, M. D., Surgeon to the Agnes Hertzler Memorial Hospital, Halstead, Kans.; Professor of Surgery, University of Kansas.* First edition. 248 pages, 206 illustrations. J. B. Lippincott Co., Philadelphia, Montreal, and London. 1938. Price $5.

This monograph is packed with pertinent knowledge and rife with photographs of patients and of specimens, both gross and microscopic,

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which are invaluable. Benign and malignant lesions of the lips, gums, mouth, tongue, palate, nasopharynx, larynx, jaws and mixed tumors of dentigerous origin are discussed from their earliest appearance to their final conclusions. After reading this book anyone, who can look back on 20 or more years of medical practice, can hardly help but wish he might long ago have had the benefit of the author's experience, especially in regard to lesions of the lips.

To those who are familiar with Doctor Hertzler's other books it is needless to say this one is written in his inimitable, unique and entertaining style. As one reads the patients pass in review, and it is apparent the author is speaking from first hand knowledge rather than quoting from the musty pages of texts and journals. The author's praise of the photographer must be echoed, for the pictures are truly excellent.

This book completes his series of 10 monographs on surgical pathology, and it is deeply regretted that the author is contemplating trading his "pen for a lollipop;" however it is believed and hoped, to use one of the author's own phrases from another of these volumes, "an old maverick with tail aloft" will again dash upon the literary field.

The publishers are to be praised for their art of binding and printing, and the book is unqualifiedly recommended to everyone of the medical profession.

DISEASES OF THE SKIN, by *George Clinton Andrews, A. B., M. D., Associate Professor of Dermatology, College of Physicians and Surgeons, Columbia University.* Second edition. Octavo of 875 pages, with 938 illustrations, W. B. Saunders Co., Philadelphia and London, 1938. Price, $10.

The subject matter has been well presented. Numerous photographs and drawings add considerably to the description. Chapters 3 and 4 are devoted to a discussion of Roentgen-ray and radium therapy which should be of value to those who are not familiar with these forms of treatment. Revisions in the text of the first edition and additions of over 75 new diseases in this the second edition makes a valuable book for text or reference.

LABORATORY DIAGNOSIS OF SYPHILIS, by *Harry Eagle, M. D., Passed Assistant Surgeon, United States Public Health Service, Washington, D. C.; Lecturer in Medicine, Johns Hopkins University Medical School, Baltimore, Md.; Formerly Assistant Professor of Bacteriology, University of Pennsylvania.* First edition, 440 pages. C. V. Mosby Co., St. Louis, 1937. Price $5.

This is a book that should be read by all those interested in the laboratory side of the diagnosis of syphilis and as well by the clinician who so frequently is confronted with problems of interpretation of laboratory findings.

In no other one recent publication will be found a more lucid and comprehensive exposition in so few pages which deals with the laboratory study of syphilis, the significance of the findings therefrom, and

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explanations of what are believed to be the underlying physico-chemical mechanisms of the complement-fixation tests, the various flocculation tests, and the collodial tests.

Dr. Eagle considers Wassermann technics, seven flocculation tests including his own, and the various spinal-fluid tests, and indicates his opinions regarding them.

This book helps to bridge the gap between the clinician on the one hand, who frequently lacks a full knowledge of the deficiencies and virtues associated with the laboratory studies of the various phases of syphilis, and the laboratory worker on the other hand, who is striving to develop and practice improved technical methods which will increase the accuracy of diagnosis. Closer cooperation and understanding between the clinician and the laboratory worker will facilitate a solution of the many pressing problems in the sero-diagnosis of syphilis which Dr. Eagle outlines and which so urgently need further investigation.

The clarity and conciseness of Dr. Eagle's style are much appreciated when one finds himself able easily to follow and understand the author's explanations and line of reasoning in a category which is usually so befuddling to the average clinician.

Although Dr. Eagle has altered somewhat his own modification of the flocculation test for syphilis since the publication of his book, the general worth of the contribution remains.

HANDBOOK ON SOCIAL HYGIENE, Edited by *W. Bayard Long, M. D.*, and *Jacob A. Goldberg, M. A., Ph. D., F. A. P. H. A.* with a foreword by *Edward L. Keyes, M. D.*, 12 mo, 442 pages, illustrated with 62 engravings. **Lea & Febiger, Philadelphia, Pa., 1938. Price $4.**

In this book there are 21 chapters on the various phases of social hygiene in its relation to the venereal diseases. Each of the chapters is written by a leader in the particular field of which he or she writes. Sixty-two engravings increase the value of the work. This book is recommended to all who are interested in the venereal-disease problems. Physicians as well as laymen will get valuable information from its pages.

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THE DIVISION OF PREVENTIVE MEDICINE

Commander C. S. Stephenson, Medical Corps, United States Navy, in charge

WHY EPIDEMICS [1]

By K. F. Meyer, Ph. D., M. D., University of California, San Francisco, Calif.

Throughout the lapse of time and during the various periods of human culture, the problem of the infectious diseases has maintained its significant importance which will continue, perhaps with modifications in the future. More than half of the deaths and probably an even higher proportion of the sickness of mankind is caused by the infectious diseases. The enormous advances which are intimately connected with the names of Jenner, Pasteur, Lister, Koch, Roux, and von Behring have merely altered the conditions quantitatively with respect to location and time. But the suppression of certain epidemic diseases has in no way influenced the general situation. It must be recognized that the human race is condemned to a continuous struggle which can never be permitted to relax without risking the loss of the laboriously acquired successes.

The law of **causative specificity**, which postulates that the morbid responses in an infectious disease are subordinated to a specific disease-inciting agent, clearly necessitates a thorough appreciation of the diversity of measures required to meet the variable manifestation of disease. Since the days of Pasteur and Koch, our knowledge of this multiplicity has been greatly enhanced. With the improvement of the investigative methods, new disease entities of hitherto unknown infectious processes have made their appearance. To be sure, the number is steadily increasing and there is no reason to believe that an end has as yet been reached. In consequence, further dissipation of efforts both in scientific and in the practical administration of public health will be unavoidable.

In what manner have the human race and the animal kingdom become subject to this multiform epidemization? What maintains its existence? Is there some hope that what nature has created may again be destroyed? In other words, is it reasonable to expect that prevailing epidemic infections may vanish without direct human interference?

[1] From the George Williams Hooper Foundation for Medical Research, University of California, San Francisco, Calif. In part offered as Faculty Research Lecture in 1937.

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An attempt will be made to answer in part these pertinent questions. Such an inquiry may well serve as a guide to fundamental matters on infectious diseases and thus engender interest in the "birth, life, and death of an epidemic."

The dawn of bacteriology was not interested in these questions. An elucidation of the nature of the infections prevailing at that time promised results of great practical and theoretical significance. Since the expectations were richly rewarded, the trend of research assumed the form of an extreme and one-sided search for cause or causes. Once the foundations of the newly discovered field had been laid, the **concept of disposition**, temporarily neglected in favor of the exerting search for the disease agent, assumed its dominant rôle. As late as 1891 Rosenbach, a pupil of R. Koch, criticized the unilateral study of the mode of transmission of the individual human or animal infectious unit, and proposed the **realization of the epidemic as a natural mass or herd phenomenon.** Thus was brought to the surface the problem of the rise and fall of epidemics. Further, this newer idea supplied a sounder supposition for the development of rational control procedures.

INFECTION as viewed from the standpoint of the naturalist is analogous to or identical with the **biological phenomena of parasitism** so widely existent throughout the animal and plant kingdom. The parasites, macroscopic or microscopic or invisible, live on or within their respective hosts while the **injury to the host**, the disease of man or animals, **is quite secondary.** It is incidental and therefore not necessarily a part of the infection. Until quite recently the medically oriented microbiologist approached the infectious disease not from the standpoint of the agent but rather he placed in the foreground of his observation and action the altered state of the host. With the recognition of the so-called **latent infections** and the **infections without an infectious disease**, this strictly utilitarian concept was found untenable. Today these latent infections familiar to the layman as the so-called carriers of bacteria are commonplace processes. It is well to recall that their original discovery in man during the cholera epidemic at Hamburg in 1891 created memorable consternation since the prevailing ideas made the existence of a "pathogenic microbe" in the body of a healthy human being inconceivable. Disease-producing action was considered at that time the medically important integration of parasite and host. What remarkable changes have taken place? Practically every important disease displays either as a stage or during its entire course a symptomless existence. In malaria, relapsing fever, and certain septic processes, periods of latency alternate with those of obvious manifest disease. On the other hand, the so-called "quiescent" infec-

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tions such as tuberculosis and leprosy long remain unrecognized on account of their tendency to latency.

For many years, those who studied in the temperate zones the newly discovered undulant fever disease made the intriguing observation that a fairly large percentage of persons, who had been exposed to the risk of infection with the Brucella organisms specifically associated with this malady, would reveal in their blood serum specific antibodies. Clinical undulant fever was quite infrequent in these occupational groups despite their intimate contact with infected livestock. Various explanations were offered but not until a skin test, in many respects similar to the tuberculin test, had been developed was it possible to prove or disprove the interpretation of these epidemiologic data. Systematic allergic skin tests with the protein prepared from the Brucella organisms on large groups of employees in slaughtering establishments, disclosed the fact that all those who gave positive reactions failed to contract the disease. A painstaking scrutiny of the past history of these people revealed no evidence of any sickness even remotely resembling undulant fever. Students, who gave definite skin reactions, had during their studies spent a considerable time in the slaughterhouse handling the viscera of hogs in the search for various parasites. There is now available a great deal of experimental evidence to prove that the Brucella bacteria present in the organs of cattle and hogs rather frequently infect persons who are exposed by contact. These infections generally remain latent; their occurrence, past or present, can be detected only by these refined methods of examination.

On the African continent yellow fever operates entirely as a latent infection. Members of the Rockefeller Foundation found that when the blood serum of recovered patients is mixed with the brain substance of mice infected with the yellow fever disease agent and then inoculated into normal monkeys or mice, as a rule these animals survived. This protection is a definite indication that previously the patient had been infected with the disease. Employing this method, the investigators have been able to detect the existence of yellow fever in villages where no obvious signs of the disease were present. The infections were inapparent and without the manifest clinical signs of yellow fever. Many more examples from an endless chain could be cited to stress a fact which is rarely appreciated in its proper perspective.

The biologic definition—host—parasite relationship—answers the pertinent inquiry concerning the primary origin of the infections as identical with the genesis of parasitism. Ultimately every parasite has descended from an independent free living organism through predatory habits to a state of perfect adaptation in a host. The final process of being adapted, so eminently imprinted on the parasites in

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the form of structural and functional adjustments, precludes an independent existence. Moreover, a great many parasitic species possess as a phylogenetic relic of their original autonomy the vitality to exist outside of the host either during their entire life cycle or at least during certain of its phases. Finally, the most convincing and decisive argument has been furnished by the **experimental transformation of free living organisms into obligative or at least facultative parasites.**

These deliberate experimental reconstructions of the intimate integrations between different organisms clearly expose the pathways which may be chosen to unravel the secrets of the host-parasite relationship. From the amoeba ascending to the highly developed man, the **ability to accept parasites progressively increases.** With advanced organizations of the hosts, the number and variety of the parasites which attack them correspondingly multiplies. Although no exact comparative tabulations are available, the recently published list by F. B. Gay of 742 diseases of man induced by animate agents represents the maximum of parasitism thus far observed in the animal kingdom. Finally, one and the same parasite inhabits closely related species of animals and plants; thus the asexual developmental stages of the malarial parasites may reside in the red blood corpuscles of man and the anthropoid apes (Reichenow), while the sexual forms develop in the stomach of the Anopheles. As yet merely outlined, these phenomena of adaptation sketch an evolution of disposition. There is no doubt that already in the early phases of organic life the phenomenon of infection left indelible marks. As general or even specific dispositions to certain parasites, these effects survived the ascending integrations of the host. For example, the increased susceptibility of certain people to carbuncles or habitual erysipelas is dismissed with the meaningless negative statement that recovery from this and similar infections leaves no immunity. Yet this specific ability to become infected is transferred from the ancestors to the descendants, has developed under the influence of the parasitism the perfection it reveals today, and continuously enhances the chances for repeated attacks.

Diseases, as for example, anthrax, glanders, hoof and mouth disease, Bang's disease of cattle and hogs, Malta fever of goats, rabies, parrot fever, and others maintain themselves as epidemic scourges in continuous transmission chains among certain animals. Occasionally, human beings become infected. These accidental infections, as a rule, end blindly and a transfer of the parasites from the infected human being to his contacts occurs only under exceptional and rare circumstances.

Searching inquiries in many countries and on thousands of patients have failed to disclose secondary infections with the undulant fever

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organisms. Human to human infections due to the parrot fever virus were suspected as early as 1892, but conclusive proof was furnished only during the recent investigations in California and Pittsburgh. An elderly lady who had been exposed to a sick parrot in a department store was nursed by her sister and, although she finally recovered, she transferred through her sputum the disease agent and fatally infected her relative who had never been exposed to the sick bird. For the first time the virus was demonstrated in the contact case. These and similar observations indicate a preexisting susceptibility as an inherent human characteristic. However, an adaptation of these parasites to man through his evolutionary ascendency has never taken place.

What disclosed itself in the spontaneous diseases has been broadened by experiments. Our factual knowledge has been greatly enlarged by deliberate transmissions of diverse infectious processes to heterologous, artificial hosts remotely related zoologically and which are never infected under natural conditions. Indeed, combinations previously considered impossible have been successfully created without subjecting the microorganisms to a prolonged period of adaptation. According to Kolle and Schlossberger, white mice may be readily infected with the Spirochaeta of human syphilis; the parasite remains latent in the brains for over 1 year. Equally conclusive and from a practical standpoint very important, are the transmissions to white mice of bird infections such as fowl plague (Doerr et al) and parrot fever (Krumwiede), the yellow fever and sleeping-sickness virus and other specific diseases of man. Dog distemper has been transmitted to monkeys, and fowl pest has caused infections in ferrets. Strikingly, the disease in these animals resembles that induced by the human influenza virus.

The scientific horizon concerning typhus and Rocky Mountain spotted fever has been widened by the discovery that guinea pigs, rabbits, and rats possess variable dispositions for the Rickettsia organisms. In the field of helminthic infections, the enforced localization of the larvae of Trichina in the muscle of birds (Doerr and Schmidt) has not received the recognition it deserves. To be sure, many of the scattered observations have not been analyzed in the light of the above concepts but certain consistencies project from the mass of bewildering and contradictory facts. For example, the exceedingly broad range of dispositions among the rodents, the guinea pig, the white mouse, etc., suggest a common historical origin.

The parasitic diseases of man and animals are obviously a part of a broad evolutionary development. Many of man's ailments may have antedated his arrival, while others may have accompanied him through the generations of his ascendency. The majority probably evolved during the historical growth of the human races primarily as adapta-

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tions due to predatory or free living organisms and secondarily by accepting parasites of other animal hosts through so-called life or host cycles. Neither the available facts nor even speculation offer enough leads for the selection from the three possibilities of the one most likely to be involved in the origin of a present day infectious disease. A primary development within man is most likely to have taken place in a disease which is not transferable to any known species of animal. It is important, however, that the probability must be kept in mind that the parasite may have been transmissible to some of the extinct species or that the one-sided adaptation for man was secondarily acquired through retrogressive loss of original properties.

The plant pathologist has experimentally observed nematodes adapt themselves through several generations to such a degree that they are unable to infect the original host plant. Thus intimately interwoven with the integration of the disposition of the hosts is another genetic factor, the **biologic plasticity** of the parasite. The lowly organized unicellular organisms, bacteria, spirochaetes, and ultramicroscopic disease agents, exhibit this property to a remarkable degree. Even in short-lived laboratory experiments, they may develop interesting morphologic and biologic variants of one sort or another.

The transformation of the smallpox or variola agent by passage through the skin of the calf into the harmless cowpox or vaccinia virus is well-known since this mutation forms the theoretical basis for the Jennerian antismallpox vaccination. The ability to invade the tissues may be enhanced at will by rapid passage from animal to animal, or a pathogenic microbe may be robbed of its infectiousness by continuous cultivation on unsuitable culture media. That a disease-producing microbe degraded to a saprophyte may, under certain decidedly limited and meagerly understood conditions, have its infectiousness restored merely sketches the far-reaching boundary lines within which the variability of parasites may manifest itself. Finally, the following type of variation deserves attention: If a disease agent, which is noninfectious for host A, is passed through an artificial host B, it may acquire the power to invade host A. For example, the filtered nasal washings from a human case of influenza are noninfectious for the mouse. However, they induce a fatal disease in ferrets. The juice extracted from the lung of the diseased carnivore now infects mice. It is well to remember that these are merely laboratory experiments which create no new species, but modify certain properties of the already existing parasites. They permit, however, an insight into the unlimited kaleidoscopic store of variations which have exerted their powerful forces from time immemorial. One may conclude, therefore, that the forces making for disease have always existed and are everlasting.

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The written history of the parasitic diseases of man embraces an infinitesimally small epoch of time. From the works of his hands, namely, writings, paintings, etc., and the bodily remains of man himself have been woven the accounts of deeds and suffering of the human races through many thousands of years. The accuracy of the account depends on the nature of evidence contained in the records and the correctness of the interpretations. This evidence becomes more difficult to unravel the older it is. It will, therefore, be readily understood that in respect of the various aspects of disease, no evidence other than those of the bones has survived. But inasmuch as most illnesses do not affect the osseous structure the first conclusive evidence of the prevalence of parasitic diseases of man is disclosed within the period of written history approximately 5,500 years ago. But the accounts are vague, exaggerated, or untrustworthy and blurred as to the all-embracing designation: epidemic or pestilence. In the Book of Genesis, the phenomenon of epidemic is established for it is recorded that Moses and Aaron, when they made their first request to Pharaoh that the Israelites might leave Egypt, expressed the fear that God would send a "pestilence" amongst them if they failed to carry out His commands. The epidemics of "boils and blains" or "plagues" which followed the progress of the Ark of the Covenant are not described with sufficient detail to permit the historian of epidemics to recognize them. The outbreak of infectious diseases described by Thucydides as having raged in and about Athens during the second Peloponnesian War, 430 B. C., is the first epidemic in history to be described in detail. Different medical writers have grouped it with plague, typhus, smallpox, influenza, erysipelas, and scarlet fever. No final identification has been made. It may have been either a disease unknown to us which has long disappeared, though that is quite unlikely, or a disease which is at the present time rarely epidemic. There is no doubt that certain of the infectious diseases have been much more prominent epidemically than others, namely, plague, influenza, cholera, and smallpox. These have been and still are the big four of the infections.

Again and again attempts have been and are still being made to read from transmitted documents that new infectious diseases originated within historic times. Many authors believe in the recent origin of cholera, epidemic meningitis, undulant fever, sleeping-sickness and the sweating sickness. The latter appeared as an epidemic in 1485 and was supposed to be a new disease which had its origin in England. From a judicious consideration of its clinical symptoms and epidemiological behavior one must conclude that it was nothing more or less than influenza. Without going into further detail, it may be stated that it is highly doubtful that new diseases have been in progress of development during the times which can be

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historically surveyed. However, one fact is fully documented in the historical accounts of the notable epidemics that certain infectious diseases have been smuggled into regions in which they were previously unknown. The reports are so numerous and the documents embrace so many different diseases such as syphilis, tuberculosis, small-pox, measles, leprosy, diphtheria, infantile paralysis, etc., that the few exceptions which fail to meet a particularly severe critical analysis are of minor significance. In fact, modern epidemiology accepts these misplaced peregrinations of contagious diseases as self-evident phenomena and merely investigates the catastrophic consequences.

It may not be out of place to illustrate this state of affairs with concrete examples.

PARROT FEVER or psittacosis attracted little or no attention as a malady of certain occupational groups, the breeders of parrakeets, until the distribution of diseased birds caused epidemic outbreaks in various parts of the United States. Far-flung studies proved the existence of a parrot fever in a latent state among the many hundreds of thousands of pet birds raised in captivity during the past 5 to 8 years. Since the breeding stock originated in Australia or South America, it was reasonable to suspect that the source of the infectious disease would be found in the jungles of the two continents. That this assumption was correct was fully proven by the demonstration of the disease agents in the native birds. Brought to the American shores, the intensive breeding operations, encouraged by greed for financial reward, enhanced in various ways the relatively mild character of the infections, and thus created the factors leading to epidemic latency and its disastrous consequences.

Probably no more interesting example than the history of yellow fever elucidates this behavior of an infectious disease. Since the famous discovery in 1900 of the manner in which this disease is transmitted by the little delicately striped mosquitoes, *Aedes aegypti*, antimosquito campaigns seem to have eradicated yellow fever from most of its endemic centers in the New World. In fact, by 1929 there was good reason to believe that before long it will have disappeared from the urban habitations of the Western Hemisphere. However, with the recognition of the disease in rural communities of Brazil, Paraguay, etc., as socalled "jungle fever," the characteristics of the malady have changed. Mosquitoes with different habits serve as transmitters and animals like monkeys and apes probably act as hosts. The epidemic disease has, therefore, acquired a different pattern from that commonly seen in the cities. Again the hydra-headed monster of yellow fever looms on the horizon of the United States. The intensive trans-American air traffic passing over the mosquito infested jungles readily picks up insects and as observations clearly substanti-

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ate may bring to the southern states the seeds of a disease which recent generations have nearly forgotten. International agreements demand that the interior of the plane in flight must be treated with anti-mosquito spray every 2 hours, and the surroundings of the airports in the southern states must be freed from mosquitoes for a circumference of 5 miles.

Although the origin of yellow fever is not conclusively established, the recent comparative geographic studies on insects furnish weighty evidence. The *Aedes aegypti*, the main transmitter of yellow fever, belongs to the African family of mosquitoes which thrive in the vicinity of human habitations. Thus intimately attached to man, it accompanies him on long water and rail voyages. Thanks to human travel, it received a world-wide distribution and with the discovery of the Americas it crossed the ocean from the east to the west. The nestling in of the Aedes and of yellow fever in America are the **resultants of European cultural efforts of far-reaching consequences.** Yet the white man, who has assisted yellow fever to conquer a new continent, has fortunately discovered the means to suppress it even if he never will be able to eradicate it.

These transportations and establishments of the infectious diseases have, aside from practical, also theoretical interest. It is well-known that a parasitic disease, prevalent in a certain region, rarely if ever disappears. It persists tenaciously despite sanitary control measures. Consequently, any region, small or large, which is still free from certain diseases, is not an old or extinguished focus. Increased and intensified traffic by water, rail, and air, inter- and intra-continental travel has greatly narrowed and diminished the number and expanse of the territories exempt from disease. A spread from east to west on the European continent is not surprising if one remembers that the larger part of the population of the world live in Asia under conditions of insanitation and crowding. These and other considerations leave little doubt that the majority of communicable diseases of man originated in certain population groups, and their spread was entirely secondary. This so-called "monocentric" concept of the origin of contagious disease offers no answer to **when** and **where.** However, an appreciation of the genesis as outlined should greatly encourage the sadly neglected field of historic-geographic pathology, which may furnish the material to elaborate the ideas here expressed. An example of the problems involved is furnished by the discussions which arise in connection with the origin of syphilis. Despite all of the historical research, it is not possible to state definitely and unequivocally whether or not it was imported to America from the Island of Hispaniola. Until the leading pathologists have agreed upon what constitutes irrefutable evidence of syphilitic disease of the bones, their *dicta pro* or *con* must be rejected. A further study of the skeleton remains, both in Europe

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and the Americas, may help to clarify the contradictory literary evidence. Until then the origin of syphilis must remain undecided.

The rapid spread of a communicable disease in a new environment appears as the **natural consequence of the uniformity of the hosts.** The continuous and rapid exchange which takes place is not a respecter of races; lues, leprosy, and smallpox have been passed from the colored race to the white and vice versa. This susceptibility, which is independent of the specific disposition, deserves a critical analysis and an explanation.

The doctrine of the living causes of disease, the *contagium animatum* and the *pathologia animata*, visualizes an infection as a struggle between parasite and host. Observations taught the simple fact that the host may succumb to the onslaught of the disease agent while at the same time the parasite may be destroyed in the tissues of the host. Doubtless a very fruitful theory, since it stimulated and created in the field of immunology a study of the mechanism which the infected body provides and mobilizes to defend itself against the invaders. However, the apparently logical supposition that parasites are antagonists is a fundamental error. In his brilliant treatise on "Animal parasite and his messmates" van Beneden wrote in 1876:

> The parasite is he whose profession it is to live at the expense of his neighbor, and whose only employment consists in taking advantage of him, but prudently, so as not to endanger life. He is a pauper who needs help, lest he should die on the public highway, but who practices the precept—not to kill the fowl in order to get the eggs. It is at once seen that he is essentially different from the messmate, who is simply a companion at table. The beast of prey kills its victim in order to feed upon his flesh; **the parasite does not kill**; on the contrary, he profits by all the advantages enjoyed by the host on whom he thrusts his presence.
>
> The parasite fights only one struggle—that of survival and the maintenance of its own species. His mode of living greatly intensifies this struggle. **In a continuous sequence, he must find new hosts.** The entire existence of the parasite rests on the **linkages which pass from host to host** as the so-called "host or infection chains."

A quick and regular destruction of the hosts would be most impractical and an extension of the chains would ultimately seal the fate of the parasite.

The methods which insure this continuity of transmission vary with the different infections. Some appear practical as, for example, in tularemia, Rocky Mountain spotted fever, and plague, by which the transmission of the parasites is assumed by two or several different hosts. The localization in those organs or tissues which provide for direct exits into the environment correspondingly aid the parasite in finding a new host.

These pathways have a definite purpose. Should the portal of entry be identical with the site of localization and multiplication of the infective agent, the mode of escape or discharge is already established. Exit and terminus of the parasite rest in the same organ or tissue.

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Cholera, typhoid, and dysentery are transmitted from "intestines to intestines," influenza and whooping-cough from "lung to lung." A tendency on the part of the parasite to protect the host until it has fulfilled its function is indicated in a number of diseases. Whenever practicable, the physiologic functions of respiration, nutrition, and procreation are exploited to the advantage of the disease agent. Yet notwithstanding these benefits, the paramount role, namely, the preservation of the parasite, is quite often left to factors of pure chance. A capricious action on the part of a host, a mere touch may establish the chain.

Viewed from the standpoint of the biologist, one cannot escape the conviction that the modes and methods chosen by nature are doubtless incomplete, even irrational. Despite these inadequacies, the parasites and consequently the microbic diseases continue to maintain themselves. Certain infections have existed for nearly 3,000 years, but no disease of man or domestic animals has disappeared. Granted that the historic periods of observation are short, but it must be remembered that during the same interval the dying out of free living animals and plants is not only documented by palaeontologic but by historical data. All the vicissitudes of inadequate and accidental transmission and the gigantic processes of destruction to which the parasites are exposed have been overcompensated, and as long as natural hosts in adequate number and proper intimacy maintain the infection chains, it is futile to anticipate a progressive extinction of the parasitic species.

The firmly entrenched position of certain epidemic maladies may at first appear unintelligible and mysterious. Measles attacks man once, rarely twice, during his entire life span. The immunity conferred by this single infection may last until death. In the language of the parasitologist, the disease has thus converted a suitable into an unsuitable host. Although measles is one of the oldest infections of mankind, its extensive epidemization and the continuous reduction of the hosts has merely converted it into a disease preeminently observed in early childhood. How can this contradiction be explained? The laws of genetics may offer an answer.

In 1900 the Swiss physician and naturalist, Naegeli, reported the interesting fact that the majority of human beings (97 percent) living in Switzerland at that time were infected with the tubercle bacillus, but that a relatively small number suffered clinically from tuberculosis. Obviously, in the disposition to disease the morbid manifestations of the infection are individually variable and it is indeed reasonable to suspect in this and similar cases the influence of hereditary idiotypic factors. The study of monozygotic or identical twins by Diehl and v. Verschuer has given a truer explanation to the observation that there are families which are cursed by tuberculosis and to the former vague notion of constitutional disposition to this disease.

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In the course of these inquiries, both the clinical type and the environmental conditions were determined as far as possible. In a total of 37 pairs of identical twins, both co-twins had developed tuberculosis in 26 pairs; only one of them in 11 pairs. Conversely, among 69 pairs of fraternal twins, concordancy with respect to tuberculosis was present in 17, discordancy in 52 cases. Among 7 pairs in which both members were affected in spite of no known exposure 5 pairs were identical and 2 fraternal. In some cases, the clinical type was strikingly similar. Of two identical twin brothers, within a time interval of 4 years both developed a surgical tuberculosis in the heelbone. In the final analysis, the capriciousness in the occurrence of tuberculosis is a function of the differences in the genotypes acting under the influence of the environment; in this particular case the bacilli being facilitated by close aggregation in the family or home.

The constitutional influences are, however, by no means simple hereditary factors. From the evidence at hand, it appears that these are gene complexes which are neither transmitted nor maintained in pure lines. Genetic variability and peristatic forces more or less continuously obliterate the signs and sequelae of the constitutional evolution. There is, unfortunately, no theoretical foundation to support the expectation that families may in time purge themselves of those members who are highly susceptible to disease or that the selective survivals may transmit to their descendants the power to survive more readily the onslaught of infectious diseases. People or animals are more resistant to the attacks of the parasitic infections of their own countries and districts than to those of foreign territories with which they or their ancestors have been accustomed to come in contact. Certain diseases immediately following their introduction into a country previously exempt are particularly virulent but may in the course of centuries acquire a benign character. However, these well-known facts cannot be accepted as proofs for the selective elimination of constitutional susceptibility factors. With unremitting insistence, one must agree with Doerr that the **disposition or liability to disease** and the **disposition to infection** are two **totally separate entities.**

The selective diminution in the disposition to disease is more than an hypothesis. A great many human beings are not manifestly diseased, but they are in a state of latent infection. Such maladies as diphtheria, typhoid fever, meningococcic meningitis, scarlet fever, infantile paralysis, sleeping-sickness, etc. with variable host susceptibilities maintain themselves through carriers in which the parasite in a high percentage of human beings leads a commensal existence. An infectious disease without symptoms may be placed in evidence by direct or indirect laboratory methods, inoculation tests or serologic and immunologic procedures. To the disappointment of every experi-

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menter, latent bacterial or virus infections in laboratory animals have been made recognizable. With increasing frequency, **latent infections** are converted into visible diseases by transferring organ material of various animals to new hosts of the same or different species. In its broader aspects, the problem of **inapparent infections** permeates the problem of epidemics, since their natural fluctuations cannot be completely explained either through the frequency of the manifest infections or by the variability of the causative agents.

With increasing conviction it is being recognized that the tragedy of the events as well as the outcome of a single infection are ultimately conditioned by the **constitutional factors of man or animals** and the **hereditary history of the parasites.** Both components of an infection are being subjected to genetic inquiries. Thus far, the contributions have been modest. Notwithstanding the foregoing tentative analysis a great many of the fundamental premises are missing. Relative to the mechanism of disposition to an infection, nothing definite is known. The susceptibility to disease is vaguely suspected but by no means understood; it is indeed impossible to separate the two conditions with any degree of certainty. However, it will be a momentous step in the right direction, when authoritative investigators abandon the one-sided concept that certain mysterious properties of the incitant, such as virulence, aggressiveness, etc. solely govern the entire problem of epidemics. In a recent analysis of an outbreak of rabbit-pox—a disease in many ways similar to human small-pox—and its analogy with the latter, Greene concludes that forces affecting the human or rabbit population other than those concerned with the presence of an infecting organism and the specific immunity of the population were of greatest importance. The factors to be emphasized are first, environmental factors which affect the population as a whole and second, constitutional factors which render individuals more or less responsive to the action of environment.

The biological investigations of the past 50 years have been responsible for the present advanced knowledge concerning the individual infections, and they furnished the most important although not the only foundation for the important discipline-epidemiology. Until recently, this science of the host and infection chains studied the end effects of their interaction as morbidity and mortality. In particular, the statistical epidemiology through its consecutive registrations within a given time interval discloses definite regularities which are made the subject of inductive and deductive analyses. Although this approach has changed the pre-Pasteurian epidemiology from a descriptive to an investigative science, it has failed to furnish satisfactory explanations for the rise and fall of the mass infections. It is becoming increasingly evident that **an epidemic is not merely the summation of single infections.** The events of the past 25 years and

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in particular the experiences collected during and after the World War have revealed striking discrepancies between theory and reality. It remains indeed an unexplained paradox that Germany exposed in 1919 to 1921 to the highly contagious epidemic diseases which embraced millions of cases in Russia remained practically untouched. A personal inspection in 1922 left little doubt that even under ordinary conditions, a rapid dissemination among large population groups would have appeared unavoidable. The prevailing circumstances were exceptionally favorable for the spread of infectious diseases. The protective measures along the frontiers had completely broken down; irregular mass migrations of hundreds of thousands of prisoners, remnants of dislodged army corps, and refugees from the epidemic territories had taken place. The position of Germany was just as hazardous as it was following the retreat of Napoleon from Russia in 1812. Thus the sessile population of Germany in 1813–14 suffered a typhus spotted fever mortality of from 200,000 to 300,000 people. Yet despite an average mortality of 2.2 million people in Russia during the year 1919, the German statistics record only 527 deaths from the same disease. In the majority of instances the cases involved were refugees who had contracted the infection before they crossed the borders. Concerning the factors responsible for these striking differences, very little accurate and reliable information is available. A careful scrutiny of a few cities and towns convinced me that the intelligent appreciation of the principles of personal hygiene was of prime importance. The women of the workers and the peasants without special knowledge of the intricate biological relationships deloused the refugees and removed other conditions inimical to health. Strangely, the officially created public health agencies as, for example, the central delousing stations remained unused.

Although nothing can happen in an epidemic which has not already been founded on the single infection, the companionship of the innumerable animal and vegetable creatures engaged in a continuous struggle for food and procreation ultimately aiming at an equilibrium to perpetuate and maintain every single species has created a multiple factor problem. The microcosmos of the single infection composed of two variable factors is thus contrasted by the macrocosmos of the epidemic. This comprehension and no other makes intelligible the appearance or the absence, the regular or the irregular periodicity and the rise and the fall of epidemics. The epidemiologist of to-day must fully recognize that the continuously changing interplay of cultural, social, and economic factors are equivalent with the purely biological forces. Since the discipline furnishes the foundation for the control measures against infectious diseases, epidemiology must constantly remain cognizant of the variety of conditions which must be evaluated in the analysis of mass illnesses.

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An example recently called to my attention may serve to illustrate the complexities of the interactions.

A South American railroad company decided to plant 10,000,000 eucalyptus trees along their tracks. However, the continuously occurring prairie fires destroyed the young trees. In order to combat this hazard, the official in charge of the agricultural activities of the railroad introduced cattle. The effect was immediate; a young succulent green vegetation displaced the high grass which in its desiccated state was so inflammable. Prairie fires ceased and the trees grew rapidly. However, the well-known fly—*Dermatobia hominis*—attacked the cattle and in due course every animal became the host of the larvae which develop in the hide of the beasts. In consequence, the entire livestock and 44 percent of the inhabitants of the region became infested. As many as 100 boils harboring the larvae of the flies were observed on one single human being. Without any doubt, the cattle were the reservoirs for the flies. The officials, therefore, decided to replace the cattle by horses which are less suitable for the growth of flies. Within 2 years the percentage of infection among the horses was less than 5 percent and correspondingly the larval disease or myiasis among the inhabitants in time disappeared. The problem was solved. The horses accomplished the primary task by reducing the inflammable prairie grass but since they were a poor reservoir for the flies they also controlled the number of the human infections.

To predict or to prognosticate the outcome of a single infection or disease is one of the most important tasks assigned to a physician. Invariably it subjects his ability, his knowledge, his power of observation, his memory and his appreciation for essentials to a severe test. With the progress of the diagnostic procedures, the medical prognosis has correspondingly advanced. A reliable predication of certain epidemiologic events faces a much larger and much more complicated task. In its consequences, it is far-reaching since the result affects not a single individual but a community, a state, or even a continent. A false prediction may have serious and protracted consequences. The scientific foundations for the prognosis of epidemic events are by no means adequate. In certain exceptional instances it may be attempted, provided the host transmission chains are not subjected to a great many accidentally irregular factors.

The character of the epidemic wave during the first weeks of an epidemic year may prognosticate the trend of the disease during the entire calendar period. Equally potent on the course of an epidemic are economic and cultural factors. From the number of illiterates, conclusions relative to the spread and course of an epidemic may be predicted. However, the scientific evidences at hand are not sufficiently sound to venture a prognosis concerning the probable severity of an impending epidemic. Logic and arithmetic can measure some of the phenomena observed in epidemics, but abstruse problems and riddles are still in abundance. For example, the seasonal occurrence of an infection is only satisfactorily explained in the diseases dependent upon insect transmission. Explosive outbreaks of intestinal infections, such as typhoid fever and cholera, may be interpreted, but the condition conducive to similar sudden mass illnesses caused by

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dengue fever or influenze are not known. The age and sex incidences of communicable diseases are uncertain quantities, since the mortality and such morbidity data as are available afford only meager approximations. The great pandemic of influenza in 1918–19, the rise of the virus diseases of the central nervous system, the disappearance of plague in rats and its corresponding spread in wild rodents as well as the extreme mildness of smallpox are events which may shake one's confidence in the pragmatic philosophy of the bacteriological and the serological laboratory. That such an attitude is not justifiable is clearly demonstrated by the progress made during the past years. The cause of influenza, its probable transmission by droplet nuclei has been recognized. Greater familiarity with the viruses has thrown light on the infection of the central nervous system. Until recently, no explanation could be offered for the observation that human malaria carriers and Anopheles mosquitoes could exist in the same region without epidemic distribution of the disease. Inductive epidemiology recorded this phenomenon as "locality immunity" without offering an explanation. Swellengrebel, by means of laboratory tests, clearly showed that the zoological relationship of a mosquito belonging to the *Anophelinae* does not necessarily stigmatize such an insect as a vector of the malarial parasites. Certain varieties of Anopheles are not endowed with ability to encourage and maintain the multiplication of the ingested gametes. The pathway of infection, an integral part of the malarial infection due to the absence of suitable mosquitoes, is, therefore, nonexistent.

Many additional examples could be cited to illustrate complicated situations which are not subject to synthetic analysis. Despite this unsatisfactory state of affairs, it is rational to adhere to the facts presented by the epidemiologic phenomena. In so doing, it is immediately recognized that man through his activities **may effectively interfere and interrupt the host and infection chains.** His actions may be intentional or accidental, palliative and even radical. Social reforms beyond any doubt have been primarily responsible for the complete disappearance of certain infectious diseases in territories inhabited by millions of people. These planless but radical effects of a progressive civilization prevent or continuously hinder the particular pathways of transmission. Bubonic plague has always been said to be a disease of primitive civilizations. After the middle of the seventeenth century, it surely and steadily receded from Europe and at the close of the nineteenth century, it was almost forgotten. It was known to exist only in the remote parts of Africa, India, Persia, and China. These great changes, particularly in England, were effected by the agrarian revolution which began about 1730 and lasted until 1845, and changed the housing of the people and their social habits. Previous to this social revolution, men lived in poorly constructed clay-

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walled chimneyless homes in a single room with the cattle, pigs, and poultry. In such circumstances rats were brought into close propinquity to men and so favored plague condition. Other diseases in addition to plague and malaria were equally banished by the social reforms; leprosy, relapsing fever, cholera, etc. have disappeared from the northern, central, and western European countries. During the Tudor period, money came into more common use; rents were paid in cash and labor was rewarded in wages. Thus powerful forces affecting the mode of living followed, as automatic consequences, the economic prosperity which spread over larger and larger population groups. Today, it is fully recognized that a **successful alleviation of epidemics is not possible where the standard of living falls below the level of tolerable existence.**

In China, the prevalence of epidemic disease is due to bad water supplies, unhygienic housing conditions, ignorance and primarily the poverty of the population. Equally powerful in banning the course of epidemics has been the increased influence of the urban over rural culture. At first, this appears as a paradox since the crowding of people in large cities offers eminently effective conditions, perhaps not as to the origin but certainly for the spread of a communicable disease. For such diseases as influenza this may doubtless be true. However, comparisons of rural and city death rates usually show that the rural rate is decidedly higher. The larger the population the better are the sanitary environmental control measures. Quite generally it is now recognized that the congregation of the masses is only a disadvantage when it is accompanied by **misery and squalor.** In fact, as soon as this phase has been eliminated, striking effects are continuously recorded. Not only the permanent regional eradication of certain epidemics becomes a fact, but the morbidity and mortality due to communicable diseases generally declines. Before our eyes this process has continued its progress since the latter part of the last century. It has, in part, been temporarily interrupted by the Great War, and particularly in regions where starvation and filth created conditions comparable to those of the Middle Ages. To what extent the planned suppressive and eradicative measures had any influence on the course of these events is difficult to estimate. Doubtless they were great but a significant fraction must be attributed to the **alleviation of economic and social inequalities.** No one will deny that the continuous decline of pulmonary tuberculosis, with a death rate of from over 440 per 100,000 population in 1849 to less than 50 in 1932, has been accomplished by raising the economic level and increasing the requirements for decent living. Although phthisis, the *morbus pauporum*, as an infection will never be conquered it is reasonable to expect a further decline in the mortality, provided the economic

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factors are supplemented by general environmental conditions concerning the crowding of people.

It is, therefore, by no means Utopian to anticipate the elimination of other mass ailments through progressive sociologic growth of the white race. The significance of such an event cannot be evaluated. But despite this justifiable optimism, it is imperative to emphasize the danger of retrogression as evidenced by the terrible catastrophies of epidemic disease which flooded Russia during and after the World War. By 1922, Tarassévitch estimated that the morbidity due to louse-borne typhus was 30,000,000 people or 20 to 25 percent of the whole Russian population. With a mortality of 10 percent, the typhus deaths alone amounted to 3,000,000 people. Relapsing fever, cholera, enteric fever, dysentery, and many other infectious diseases contributed their share to the frightful carnage from which Russia emerged after the crisis with a loss of from 20 to 25 percent of her population. As chief immediate causes must be listed: Poor nourishment, famine, dirt due to shortage of soap, cold due to lack of fuel, overcrowding, unsatisfactory conditions of railroad traveling, shortage of medical supplies and deterioration of water supplies and drainage. What has taken place in Russia repeats itself elsewhere, although on a less gigantic scale. Moreover, on closer scrutiny, one notices that changes in the mode of living of the masses create more insidiously and less brutally conditions which ultimately may be reflected in the epidemic status of the nations. If social disorganization should occur in the near future, it is quite likely that the harvest would be reaped by influenza and its associates, the infections of the nervous system which are thus far unknown quantities, rather than by typhus and plague which are more controllable.

In the light of what has been said, is it then reasonable to hope for an eradication of a few infections from the inhabited parts of the world? There is ample evidence to expect such a possibility. What has been accomplished in certain regions may well be realized elsewhere on a much greater scale. Equalizations in the cultural levels of the colored to that of the white race may in the distant future contribute quite unexpectedly to the eradication of many diseases among the former.

Finally, what is the goal of the active control measures against epidemics as far as they are influenced by progress in microbiology? They are preeminently suppressive measures engaged in preventing the spread and dissemination of the infectious agents. As a whole the achievements have been quite moderate. It is regrettable that the struggle is conducted in a desultory manner without giving any indication of the ultimate aim of eradicating certain communicable diseases. The isolation of leprous patients lead to the disappearance of leprosy from central Europe. Even more impressive is the reduc-

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tion in the incidence of smallpox through the active immunization according to the method of Jenner. These examples amply attest to the significant possibilities. The partial eradication of smallpox is particularly instructive, since the same results could not have been realized by a natural permeation of the variola virus through the population groups. Similarly for a number of other diseases, experimental evidence has shown that the individual resistance to infection may be raised by an appropriate administration of the toxin of the bacillus or the attenuated variant of a virus. An obvious suggestion is that outbreaks of these diseases may be prevented by raising the resistance of all susceptibles to the risk. The time has doubtless arrived when national and international and state and municipal organizations must cooperate in the formulation of really constructive long-range programs directed towards the ultimate conquest of the principal infectious diseases. The welfare of future generations with respect to epidemics will be better served in this way than by the narrow passionate demands of the moment or of national self-protection.

The study of the infectious diseases and the epidemics caused by them, in progress since the middle of the nineteenth century, has not only removed the dangers to social and economic development but has furnished scientific and theoretical information of far-reaching importance. It has at least in part answered our question "Why Epidemics." But just as the discovery of visible disease-producing microbes influenced every field in medicine so will the study of the invisible causes of infections ultimately alter our concepts of life. Continuity and progress, both along investigative and sociologic-economic lines, is a paramount prerequisite for the protection of the people from epidemic disasters and to secure the tools for the ultimate eradication of certain parasitic diseases.

FOOD POISONING IN THE NAVY

DEDUCTIONS AS TO THE RESPONSIBILITY AND PREVENTION

By Captain G. E. Thomas, Medical Corps, United States Navy, and Lieutenant (junior grade) J. A. Syslo, Medical Corps, United States Navy

Periodically, the subject of food poisoning is brought sharply to the attention of the various naval units ashore and afloat in the form of an outbreak of epidemic proportions. In most instances, these outbreaks are as thoroughly investigated as available facilities will permit. The commanding officer of the unit involved feels the seriousness of such an occurrence, since, in practically no time, his organization is more or less completely disrupted. It is not difficult to see that should such an incident occur in a unit engaged on one or another emergency duty, disaster might easily follow and might involve the loss of many lives.

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Epidemics of food poisoning are unnecessary and in practically all instances are preventable. Aside from the primary agents, such as bacteria and other contaminants of food, the causes are not numerous. Because of the rigid inspections that food undergoes before and upon receipt and prior to preparation for consumption, food that is spoiled, deteriorated, or infected before preparation plays an exceedingly minor role in the outbreaks of food poisoning in the Navy. Food handlers are regularly examined for the presence of illness, and if found to have any infectious disease, they are removed temporarily or permanently from galleys and mess halls. Extraneous chemical poisons, accidentally introduced into food, hardly deserve mention since they are only very rarely the cause of an epidemic of food poisoning. Supposing that the food, as originally purchased and delivered, is fit for consumption, and that food handlers are physically fit, there remains but one process to which the bulk of food poisoning may be attributed. This process involves the preparation of food prior to consumption. The burden of this problem, it is believed, rests with the commissary department.

The purpose of this survey is to find the cause or causes of epidemics of food poisoning in the Navy, to search out the offenders and to focus attention on such to insure the prevention of such an unnecessary disease. To that end, a survey was made of epidemics of food poisoning occurring in the Navy ashore and afloat from 1922 to 1937, inclusive, as reported in the NAVAL MEDICAL BULLETIN. A tabulation of pertinent facts is given below in table 1:

TABLE 1.

Outbreaks of food poisoning, United States Navy, 1922–37

Location	Date	Cases	Cause	Attending circumstances
U. S. N. T. S., San Diego, Calif.	July 23, 1938	540	Boiled ham	Ham cooked day before and allowed to remain at room temperature.
U. S. N. T. S., San Diego, Calif.	July 13, 1938	31	Creamed chicken	Chicken cooked day before and allowed to stand at room temperature.
Naval Academy, Annapolis, Md.	December 1937	119	Fresh ham	Thought to be contaminated prior to delivery.
U. S. S. *Philadelphia*	September 29, 1937	108	Fresh meat hash	Ground night before preparation.
U. S. N. station, Guantanamo, Cuba.	August 12, 1937	20	Corned-beef hash (canned).	No irregularities in preparation.
U. S. S. *Nevada*	June 26, 1937	131	Cold boiled bam	Prepared day before consumption.
U. S. S. *Maryland*	February 15, 1937	34	Cold boiled ham	Prepared day before served.
U. S. S. *Arizona*	December 12, 1936	124	Cold boiled ham	Prepared day before served.
U. S. S. *Flusser*	December 6, 1936	55	Ham	Stored in warm but not hot oven before served.
U. S. S. *Pope*	December 1936	46	No epidemiological report received by Bureau M. & S.	
U. S. S. *Memphis*	December 1, 1936	45	Cooked ham	Kept in warm but not hot oven one day after preparation.
U. S. S. *California*	November 8, 1936	68	Macaroni salad (ham, macaroni, etc.)	Ham cooked and allowed to remain at room temperature overnight.
U. S. S. *California*	November 21, 1936	15	Same as above	
Marine barracks, Quantico, Va.	June 11, 1936	250	Ham and cabbage	Cooked and left overnight in container to cool slowly.

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TABLE 1—Continued

Outbreaks of food poisoning, United States Navy, 1922–37—Continued

Location	Date	Cases	Cause	Attending circumstances
U. S. S. *Saratoga*	May 12, 1936	255	Cream-puff mixture	Kept at bake-shop temperature for 15 to 16 hours.
U. S. S. *Lexington*	October 3, 1934	123	Unknown	Cause undetermined.
U. S. S. *Fairfax*	July 1934	106	Bologna	Cause not clear or convincing.
Naval air station, San Diego, Calif.	August 14, 1933	183	Veal or veal gravy	Details of preparation omitted.
Naval air station, Anacostia and marine barracks, Wash., D. C.	May 12, 1931	68	Ice	Ice handled by people afflicted with diarrhea.
U. S. S. *Stewart*	November 26, 1929	37	Roast beef	Remainder from one meal prepared as chili-con-carne for the next.
U. S. Marine Corps, Ocotal, Nicaragua.	January 28, 1929	19	Canned corned-beef hash.	Breakfast. No data as to when prepared.
U. S. S. *Patoka*	November 8, 1929	12	Crawfish purchased from vendor.	No studies made.
U. S. S. *Worden*	May 3, 1929	2	Evaporated milk	Remained in open can at room temperature overnight.
U. S. S. *Holland*	June 1, 1929	63	Boiled smoked ham	Details of preparation not given.
U. S. S. *Wright*	May 16, 1929	98	Pork-sausage hash	Prepared day before and allowed to remain at room temperature 1 day, then reground.
U. S. S. *Melville*	October 18, 1928	51	Baked beans	Prepared 24 hours before consumption and eaten as "cold beans."
U. S. S. *Procyon*	August 15, 1928	15	Veal stew	Prepared from veal used at previous meal.
Campo De Marte, Managua, Nicaragua.	September 6, 1928	23	Beef hash	Ground after cooking. Then chilled immediately.
U. S. S. *Argonne*	July 21, 1928	5	Canned corned beef	Warmed and allowed to remain at room temperature 24 hours.
U. S. S. *Canopus*	April 13, 1928	50	Fresh fish	Properly prepared (according to report).
U. S. N. station, Pearl Harbor, T. H.	1928	1	Pork chop	Contaminated by hands that handled spoiled (foul) hamburger steak.
U. S. S. *Milwaukee* (Guantanamo Bay).	February 23, 1928	39	Chicken salad	Prepared by hand several hours before consumption. (B. coli found in food.)
U. S. S. *Trenton*	February 23, 1928	44	Same as above.	
U. S. N. station, Olongapo, P. I.	May 27, 1927	49	Canned Vienna sausage.	Mode of preparation not stated
U. S. S. *Colorado*	June 28, 1927	150	Beef hash	Prepared from left-over beef. Multiple handling, heating, and cooling.
U. S. S. *Noa* (Nanking, China).	March 26, 1927	61	Liverwurst	Purchased locally, served cold. Method of preparation and handling not given.
U. S. S. *Colorado*	March and April 1927.	109	Causes suspected but not proved: 1. Swimming at Gonaives or Guantanamo. 2. Water distilled at low temperature and partial vacuum. 3. Food unlikely.	Details of food storage, handling or preparation not given.
U. S. S. *Detroit*		2		
U. S. S. *Dobbin*		1		
U. S. S. *Milwaukee*		11		
U. S. S. *McCawley*		6		
U. S. S. *California*		24		
U. S. S. *Concord*		4		
U. S. S. *Farragut*		10		
U. S. S. *Nevada*		11		
U. S. S. *Seattle*		10		
U. S. S. *Selfridge*		21		
U. S. S. *Vestal*		28		
U. S. S. *Marcus*	March and April 1927. Report-F-Cards only.	8	Lunch meat	Details of preparation not given.
U. S. S. *Mervine*		12	Fruit	
U. S. S. *Chase*		15	Lunch meat	
U. S. S. *Mullany*		1	Salad dressing or salad.	
N. T. S., Hampton Roads, Va.	March 17, 1927	101	Vienna sausage	Opened and served at breakfast. Therefore, no real reason for incriminating the sausage.
Destroyer base, San Diego, Calif.	December 27, 1926	58	Canned corn beef	Cans opened and contents ground up day before serving. Evidently prepared 24 hours before serving.
U. S. S. *Reuben James*	October 15, 1926	40	Cheese obtained from U. S. S. *Doblin*.	Product had strong odor and taste; crumbled under knife.

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TABLE 1—Continued

Outbreaks of food poisoning, United States Navy, 1922–37—Continued

Location	Date	Cases	Cause	Attending circumstances
Rifle range, Guantanamo Bay, Cuba.	October 12, 1926....	14	Cold boiled tongue..	Tongue boiled October 8, not used until October 12. Two or 3 tongues left out of chill room October 11 and then returned.
U. S. S. *California*....	September 9, 1926..	13	Fresh mackerel (not salted or otherwise preserved).	Bought, cleaned on September 8; allowed to remain out of ice several hours before further preparation.
U. S. S. *Richmond*....	October 13, 1926....	9	Chicken salad.....	Removed from cold storage previous day and prepared; replaced in refrigerator which did not function.
Marine barracks, navy yard, Philadelphia, Pa.	May 21, 1926.....	72	Food thought to be contaminated with sodium fluoride.	No report of chemical test. Clinical course of illness points to food poisoning as the more probable cause of the outbreak.
Barbecue at local beach, San Diego, Calif. Complimentary to service personnel.	September 4, 1926..	175	Cold roast beef sandwiches.	Beef obtained from local packing plant, never frozen. After preparation, left standing for 20 hours before serving.
U. S. S. *Concord*.....	May 13, 1926.....	124	Fresh beef hash.....	Meat cooked and ground on day prior to serving.
San Francisco, Rec. Ship.	April 11, 1926.....	1	Fresh mushrooms...	Gathered by person himself. Mushrooms were of poisonous species.
U. S. Naval Hospital, New York, N. Y.	March 21, 1926.....	85	Canned milk used in preparing ice cream.	Believed that occasional can of milk was "bad." This is very questionable.
U. S. S. *Cincinnati*...	December 8, 1925...	40	Corned beef hash....	Removed from tins, prepared and allowed to stand 10 hours before serving.
U. S. S. *Wyoming* (at Panama).	July 9, 1925.....	4	Bologna sausage.....	Drawn from cold storage 3 weeks prior and kept in refrigerator for 2 days.
U. S. submarine base, Pearl Harbor, T. H.	July 12, 1925.....	40	Potato salad.....	Potatoes boiled in morning, sliced while warm. Allowed to remain room temperature until afternoon; then salad prepared and served at 5 p. m.
Restaurant at Marseille, France. (Involved Ensign U. S. S. *Scorpion*.)	April 19, 1925.....	1	Lobster.....	No study; mode of preparation not given.
U. S. S. *Colorado*.....	September 12, 1925.	51	Boiled ham.....	Ham boiled previous day; allowed to cool overnight; sliced following day and served for lunch.
Naval prison, Mare Island, Calif.	August 28, 1925.....	91	Frozen liver.....	Cooked and served within an hour. Probably contaminated before freezing.
U. S. S. *Robin*.....	February 1925.....	3	Yellow jack fish.....	Fish intrinsically poisonous.
U. S. S. *Wyoming*....	April 26, 1925.....	30	Hamburger loaf.....	Beef removed from storage at 6 a. m. Loaf prepared at 2 p. m., served at 5 p. m.
U. S. submarine base, Coco Solo, C. Z.	April 4, 1925.....	278	Smoked tongue.....	Boiled day prior to serving and returned to chill room until following morning. Sliced and served at 11 a. m.
U. S. Naval Hospital, Canacao, P. I.	February 26, 1925...	19	Fresh sliced tomatoes.	Bacillary dysentery, signifying, most probably, improper preparation (cleaning).
Naval station, Guantanamo, Cuba.	February 1, 1925....	92	Fresh beef.....	Cuban beef used. Proper preparation reported. No cause determined.
Receiving ship, New York, N. Y.	(?)	51	Canned corn beef hash (breakfast).	Removed from cans day before use and allowed to remain at room temperature until served for breakfast.
Submarine base, Coco Solo, C. Z.	(?)	3	Cooked ham.....	Cooked several days previously and kept in ice box with no ice in it.
U. S. S. *Montcalm*...	July 29, 1924.....	12	Corned beef hash ...	No study made. Mode of preparation not given.

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TABLE 1—Continued

Outbreaks of food poisoning, United States Navy, 1922-37—Continued

Location	Date	Cases	Cause	Attending Circumstances
U. S. S. *New York*	July 14, 1924	400	Fresh beef hash	Cooked in afternoon, previous day, ground up and kept warm until following morning. Cooked and served.
U. S. S. *Kanawha*	(?)	1	Fried oysters	No study made. Mode of preparation not given.
U. S. S. *Converse*	April 2, 1924	4	Lobster salad	Cooked 3 days prior to serving. Kept in ice box in interval.
U. S. S. *Maryland*	April 16, 1924	265	Corned beef hash (breakfast).	Mode of preparation and handling not given.
U. S. Marine Corps, Haiti.	January 10, 1924	1	Canned shrimp	No study made. No data on preparation given.
U. S. S. *Idaho*	March 25, 1923	295	Fried meat hash	Meat cooked and ground previous day, allowed to remain in tubs until ready: for baking on day of consumption.

An analysis of this table reveals that 70 recorded outbreaks occurred, involving the health of 5,687 individuals. The suspected and proven gross causes can be listed as follows:

1. Food intrinsically poisonous	4
2. Food contaminated prior to preparation	2
3. Food contaminated between time of preparation and time of consumption	43
4. Causes of food poisoning undetermined	5
5. Details of preparation and handling of food not given	16

At first glance, it would seem that in approximately 60 percent of the outbreaks, the cause was contamination of the food between the time of preparation and consumption. That in itself is a very high incidence. Yet on closer study, the number of outbreaks due to that cause seems to be much higher. One must not lose sight of the fact that in those outbreaks listed under "Food intrinsically poisonous" and "Food contaminated prior to consumption" the cause is only surmised or suspected and that concrete proof is not given; in those instances it might have been as good an opinion to state that the food was contaminated between the time of preparation and consumption. Likewise, in most outbreaks in which the cause was undetermined or in which the details of preparation and handling of the food had not been reported, the contamination, if such existed, might have occurred from the time of its preparation to its final disposition. Conservatively, therefore, of the 40 percent of outbreaks remaining, at least 17 percent can be added to the 60 percent of outbreaks classified as food contaminated between time of preparation and time of consumption.

Again examining the table: Roughly 3,806 men were poisoned by food that had been prepared the day before serving. This food, mainly chicken, ham, beef hash, or tongue was cooked and manhandled from 16 to 24 hours prior to consumption. Whether chilled or exposed to room temperatures it was kept in containers such as

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steep tubs or other deep vessels. Warm meats in masses greater than 8 inches deep are neither chilled through in our cold boxes in a matter of hours nor are organisms killed under such conditions.

What, then, is the one factor common to this preponderant cause of the outbreaks? Since no pathogenic organisms were found in the bacteriologic study of some of these poisonings, does it mean that the cause of the outbreak was not due primarily to contamination by bacteria? It must be remembered that there are pathogenic organisms other than the typhoid, paratyphoid, salmonella, botulinus, dysentery, etc., groups which are commonly sought for in food poisoning; that these organisms although not as virulent and destructive as the organisms mentioned, may nevertheless cause widespread and violent poisoning; that these less virulent organisms may be harbored by any individual even though the latter is unaware of their presence and is not suspected of being the agent that sows the poisonous seeds; and that these organisms, given the proper soil on which to grow (food, and the benefit of room temperatures) multiply prodigiously. Here lies the answer to the first question in this paragraph. The one outstanding feature in practically all outbreaks in which contamination occurred between the time of preparation and the time of consumption is the time element itself. Food that remains at or about room temperature for a period exceeding 6 to 8 hours has sufficient time for organisms to multiply and thrive. Organisms are introduced into the food by handling and failure to observe the rules of sanitation and hygiene.

But one may state that failure to observe the rules of hygiene are causative; yet, it is possible to have contamination when every ordinary precaution has been taken by the food handlers. The introduction of the poisonous agent is not completely controllable, but the time factor which permits the organisms to multiply to dangerous proportions is controllable, and to this delay between preparation and consumption may be charged most of our food poisonous episodes. These distressing eruptions of food poisoning are not haphazard but have a definite relationship to the ship's routine. The mischief is born usually on Friday before captain's inspection, on days before admiral's inspection, gunnery practice and big ship's parties. On such occasions the medical officer as well as the commissary officer should be particularly inquisitive; such nosiness may save many a "bellyache."

From the foregoing discussion and data, certain deductions might be made:

1. Epidemics of food poisoning are dangerous to the organization of any unit of the Navy.

2. The most common factor in the causation of food poisoning is the time interval that is allowed to elapse from the time of preparation to consumption of the food.

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3. This being the case the responsibility for outbreaks of food poisoning rests with the commissary department.

To conclude, the following recommendations should be entertained in an effort to prevent further outbreaks of food poisoning.

1. The importance of cleanliness of the food handler should be stressed. This refers not only to his personal appearance and his body, but also to his habits in the galleys and mess halls. Rigid inspection of personnel should not be neglected.

2. Proper instruction in the detection of food spoilage, deterioration or infection, as in the past, should be continued.

3. Attention should be called to the existing memoranda and instructions on the preparation of foods for general mess. It should be impressed that the time elapsing between the preparation and serving of food should not normally exceed 4 hours. (Reference Bureau S&A Manual, Article 1331. Also, Navy Cook Book, 1932.)

4. It is suggested that meats which are either finely cut, ground, or sliced should be placed in shallow pans when being chilled so as to obtain a uniformly low temperature.

THE CONTROL OF COMMUNICABLE DISEASE

By Captain George F. Cottle, Medical Corps, United States Navy

The practical application of control measures depends upon education and administrative action. The known facts of epidemiology, the use of specific preventives and treatments have for the infected person, one value, for the contacts another, for the general community, another. Recommendations of action to be taken vary with the progress of the particular disease, and vary with the particular environment in which the disease has appeared. To be of most use, this knowledge must be exact and up to date.

Exact memory of the many facts upon which control depends, tends to become dim in the minds of physicians in whose daily practice communicable disease seldom appears. Suddenly faced with a situation unusual to him, he needs help. The medical officer of a naval vessel at sea cannot telephone an official of the board of health for consultation advice. For years he may have been engaged in practice which removed him from the responsibility of deciding exactly what measures should be recommended. Suddenly there appears in his ship a case of communicable disease, a potential focus from which rapid dissemination through the crowded spaces of his ship may occur. Immediately, he must be able to interpret the known facts to his commanding officer, he must be in an entrenched position to combat, if necessary, the fixed and honest faith of his shipmates in measures no longer believed to be of value by experts in public health. He must be able to teach his hospital corpsmen the technique of

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cubicalization; teach the crew of his ship, and sometimes their families, preventive measures especially adapted to the particular situation. Measures for the control of the spread of influenza, the common cold, encephalitis, gonorrhea, whooping cough, chicken-pox, mumps, measles, and German measles are still of questionable or only partial value. It is his duty to use every means at hand of practical value to prevent or to endeavor to slow up the velocity of the spread of these diseases within the ship; to prevent the sporadic or endemic focus from becoming the origin of a serious epidemic. He must search with his brother physicians for new ways of combatting communicable disease and be ever alert to isolate at the earliest moment any new disease that may make its appearance, and be quick to detect communicable disease in its earliest manifestations.

The medical departments of the military and naval services are responsible for bringing recruits into the service with such medical care, supervision, and treatment as will most readily season them, so that at the moment of battle, as many as possible will be not only free from communicable disease, but also hygienically and physically fit and in such condition that they will be able to stand up under the strain and stress of a prolonged campaign.

In the battle against communicable disease, the Navy's first line of defense is the training station. In time of war, or mobilization for war, the tendency for military necessity to demand a shortening of this period of training becomes insistent. Efforts to combat this tendency need to be based on incontrovertible facts. Military commanders will then give medical recommendations the attention which they deserve.

It is a well known medical fact and a matter of historical record that the larger the inflow of new recruits, and the more rapid that flow, the more cases of communicable disease will develop. Upon mobilization for war, the first line of defense will be less effective than now. The appearance of communicable disease in epidemic form in combatant ships will be more likely. The increased sick-lists that experience tells us will come at the onset of mobilization, will place upon the medical officer an increased need for exact knowledge of the means of control of communicable disease. Although the best medical care available will not prevent the occurrence of sporadic cases and cannot be expected to prevent in every instance the spread of disease within ships and fleets, the velocity of spread can be controlled. When it is estimated that actual battle will not be engaged in for several months, it might be advisable in special instances to reverse the public health attitude toward prevention and permit acceleration of the invasion of some of the minor, difficult to control diseases such as German measles, mumps, and chicken-pox, in order to more quickly season those who are nonimmune. However, to knowingly, or through

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relaxed vigilance, permit scarlet fever, diphtheria, typhus, or cerebrospinal meningitis to increase the velocity of its spread within a ship or a fleet, in order to gain immunity, would be poor medical practice and poor military strategy.

The United States Public Health Service has published a pamphlet entitled "The Control of Communicable Disease," report No. 1697, from Public Health Report No. 32, volume 50, of August 9, 1935. This contains the report of a committee of the American Public Health Association originally compiled in 1917, it has been revised in 1926, 1935, and 1936. This report has been incorporated in the appendix of the 1938 revision of the Manual of the Medical Department. This pamphlet is the most authoritative single document upon which to base educational and administrative measures of public health. It will be immediately at hand for ready reference by every medical officer in the Navy, and should be his most important and valued guide for recommendations relative to the control of communicable disease.

The responsibility for the receipt and distribution of men within the United States Fleet has been delegated to the base force. Newly arriving drafts of men from training stations and recruit depots frequently, in spite of the strict care of the medical officers at those stations, bring a threat of epidemic disease into the fleet. In time of mobilization for war, with the inevitable increased rate of transfer of large numbers of men into and within the fleet, an important medical function is thus placed upon the base force commander. Planning to assist in this phase of the control of communicable disease is a major function of the base force medical officer. To inject into and widely scatter throughout the fleet, on the eve of its departure, a group of men who while enroute to the fleet, have been exposed to or have developed communicable disease, may scatter foci of potential epidemic disease sufficient to threaten the efficiency of the fleet just at the time when its physical efficiency is of the utmost importance.

A force and fleet problem as well as an individual ship problem exists, and in order that proper coordination between health authorities ashore and between ships and forces of the fleet may be attained, this pamphlet is essential to the fleet and force medical officers, who share with all medical officers this responsibility for proper coordination of recommended methods of control.

A recently published fleet letter (appendix A) requires that notification of the presence of communicable diseases of potential epidemic importance be made by despatch to the Commander in chief. Thus there will be up to the minute information of the condition of the fleet so far as that condition is affected by epidemic disease, either threatened, or actually present.

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A fleet letter giving an epitome of the laws, regulations, and instructions relative to quarantine and pratique has also been published (appendix B).

CONCLUSION

The control of communicable disease in the fleet may be a matter of vital importance to its efficiency in battle.

An authoritative pamphlet of the United States Public Health Service, and two fleet letters have been distributed within the fleet to assist all upon whom this responsibility and duty rests.

If the United States Navy is called upon to fight for the safety of the country, its success in battle must not be threatened by the inroads of preventable disease.

Modern medicine can and must be so utilized that preventable disease will never melt away the man power of the commander before he can defeat the enemy.

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STATISTICS

HEALTH OF THE NAVY

The routine coding work of the statistical section of the division of preventive medicine has been delayed by the installation of new machinery. For this reason it has not been possible to prepare for publication in this issue the usual statistical summary of the Health of the Navy.

Monthly reports of communicable diseases received in the Bureau for the third quarter of 1938 recorded the following incidence of disease:

Common infectious diseases of the respiratory type.—There were 2,453 admissions for these diseases reported from the entire Navy for the third quarter of the year 1938—1,329 from the forces afloat, 1,008 from shore stations in the United States, and 116 from foreign shore stations. Catarrhal fever was responsible for 1,810 of the admissions.

Ships and shore stations reporting the largest number of cases were as follows:

	July	August	September	Total
Naval training station, Newport, R. I.	44	76	51	171
Naval training station, Norfolk, Va.	64	38	69	171
Naval training station, San Diego, Calif.	34	32	41	107
U. S. Marine Corps base, San Diego, Calif.	12	32	29	73
U. S. S. *Enterprise*	18	24	27	69
U. S. S. *Black Hawk*	52	10	6	68
U. S. Naval Academy, Annapolis, Md. (midshipmen)	10	31	24	65
Marine barracks, Quantico, Va.	22	19	14	55

Measles.—Under date of September 22, 1938, the station medical officer reported an epidemic of 14 cases of measles at the marine barracks, naval station, Olongapo, P. I. At outbreak of epidemic on September 4, quarantine of barracks was instituted with daily inspection of all personnel, boiling of all dishes and tableware, and usual precautions to prevent dissemination of disease, with segregation of town patrol at separate mess at the marine barracks. All connections between men at the marine barracks and outside were reduced to a minimum. The cases were of a very mild type without complications.

Mumps.—The naval training station, Norfolk, Va., reported 45 cases of mumps for the quarter—20 in July, 14 in August, and 11 in September. The sanitary report for the month of August from the

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naval training station, Norfolk, Va., stated that "A large proportion of admissions for mumps came from one platoon. Segregation and daily examinations of all members of this platoon was exercised."

The U. S. S. *Enterprise* reported 8 cases of mumps for the quarter; the U. S. S. *Colorado*, 6; the U. S. S. *Chaumont*, U. S. S. *Henderson*, U. S. S. *Saratoga*, and U. S. S. *Yorktown*, 5 cases each; and the Navy Yard, Washington, D. C., 2. Eleven shore stations and one ship reported 1 case each for the quarter.

One case of diphtheria was reported by the U. S. S. *Augusta*.

The Navy Yard, Boston, Mass., reported 1 case of scarlet fever in July and the monthly sanitary report from the naval training station, Great Lakes, Ill., for the month of September reported that there was 1 suspected case of scarlet fever transferred to the naval hospital, where diagnosis was confirmed, and that quarantine measures were carried out with no new cases appearing.

The U. S. S. *Hannibal* reported 1 case of chickenpox in September.

Cases of malaria were reported as follows: U. S. S. *Bushnell*, 15; naval ammunition depot, Balboa, C. Z., 7; marine detachment, Tientsin, China, fleet air base, Canal Zone, and headquarters, 15th naval district, Balboa, C. Z., 2 cases each; and marine barracks, Quantico, Va., naval training station, Norfolk, Va., and the marine detachment, American Embassy, Peiping, China, 1 case each.

An outbreak of food poisoning involving 83 men on the U. S. S. *Enterprise* was reported to have been caused by ground luncheon meat sandwiches. No special report of the outbreak has been received in the Bureau.

A seaman, second class, 20 years of age, with 1 year and 1 month's service, was admitted to the sick list on the U. S. S. *Salt Lake City* with cerebrospinal fever on August 27 and transferred to the U. S. S. *Relief* the following day. He was returned to duty on September 30.

A case of cerebrospinal fever (a seaman, first class, 22 years of age, with 3 years and 1 month's service) was admitted on board the U. S. S. *Melville* on September 8 and discharged to duty on November 18.

A mild case of paratyphoid "B" (a private, 21 years of age, with 8 months' service) was admitted to the sick list on August 4 from the marine detachment, Tientsin, China, and returned to duty September 21. A course of typhoid vaccine had been completed in January 1938.

One case of typhoid fever (a private, 19 years of age, with 10 months' service) was admitted on board the U. S. S. *Portland* on August 25 and discharged to duty on December 3. No questionnaire in this case has been received in the Bureau.

The following table of statistical data for training stations, battleships, and larger vessels indicates the frequency of occurrence of venereal diseases during the third quarter of 1938 (reported in monthly

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reports of communicable diseases) as compared with the third quarter of 1937:

Station	Annual admission rate per 1,000, third quarter	
	1937	1938
Newport, R. I.	5.21	5.52
Norfolk, Va.	30.55	51.20
Great Lakes, Ill.	9.36	6.35
San Diego, Calif.	25.30	12.51
Ship		
U. S. S. *Arizona*	29.58	132.67
U. S. S. *Arkansas*	58.31	58.42
U. S. S. *Astoria*	58.57	93.02
U. S. S. *Augusta*	226.07	358.01
U. S. S. *California*	78.38	69.51
U. S. S. *Chester*	42.11	100.16
U. S. S. *Chicago*	37.23	18.32
U. S. S. *Colorado*	29.51	167.35
U. S. S. *Houston*	61.22	89.71
U. S. S. *Idaho*	85.71	41.20
U. S. S. *Indianapolis*	51.75	112.39
U. S. S. *Louisville*	95.39	198.97
U. S. S. *Maryland*	49.08	45.63
U. S. S. *Minneapolis*	32.00	138.11
U. S. S. *Mississippi*	55.83	60.44
U. S. S. *Nevada*	43.60	76.32
U. S. S. *New Mexico*	44.75	50.72
U. S. S. *New Orleans*	28.90	129.41
U. S. S. *New York*	66.41	46.29
U. S. S. *Northampton*	45.13	102.72
U. S. S. *Oklahoma*	90.15	77.26
U. S. S. *Pennsylvania*	67.80	100.30
U. S. S. *Pensacola*	49.38	113.71
U. S. S. *Portland*	84.87	49.69
U. S. S. *Quincy*	158.59	64.90
U. S. S. *Salt Lake City*	91.74	120.48
U. S. S. *San Francisco*	88.76	69.24
U. S. S. *Tennessee*	67.45	88.05
U. S. S. *Texas*	78.52	76.34
U. S. S. *Tuscaloosa*	57.47	43.72
U. S. S. *Vincennes*	78.91	120.30
U. S. S. *West Virginia*	97.63	88.12
U. S. S. *Wyoming*	65.65	86.58

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DEATHS

During the third quarter ending Sept. 30, 1938

Cause		Navy			Marine Corps		Nurse Corps	Total
Principal	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		10,154	2,258	106,047	1,368	17,204	433	137,464
Disease								
Abscess, brain	Furunculosis			1				1
Alcoholism, acute	Dilatation, cardiac, acute.			1				1
Anemia aplastic	None				1			1
Aneurysm, basilar artery, ruptured.	None			1				1
Appendicitis, acute	Peritonitis, general, acute.			1				1
Cirrhosis, liver, atrophic	None			1				1
Encephalitis, acute	None			1				1
Fistula, biliary	Obstruction, intestinal, from external causes.			1				1
Hemorrhage, subdural	None					1		1
Hodgkin's disease	None			1				1
Nephritis, acute	None			1				1
Peritonitis, general, acute	Colitis, acute			1				1
Pneumonia, broncho-	Carbuncle, scalp			1				1
Septicemia	None			1				1
Status lymphaticus	None			1				1
Thrombosis, cavernous sinus.	Cellulitis, nose			1				1
Thrombosis, cerebral	None				1			1
Thrombosis, coronary	None	3		1		2		6
Tuberculosis, acute general miliary.	None			2				2
Tuberculosis, acute pneumonic.	Hemorrhage, pulmonary.	1						1
Tuberculosis, lymph node and meninges.	None			1				1
Tuberculosis, pulmonary, chronic, active.	None			1		1		2
Tuberculosis, pulmonary, chronic, active.	Tuberculosis, meninges.			1				1
Ulcer, duodenum	None			1				1
Valvular heart disease, combined lesions, aortic mitral.	Myocarditis, chronic			1				1
Total for disease		4		22	2	4		32
Injuries and poisonings								
Burn, multiple	None	1		1		1		3
Crush, chest	None			1				1
Crush, head	None			1				1
Drowning	None	3		4		1		8
Foreign body, traumatic, duodenum and liver (ingested bone).	Abscess, liver	1						1
Fractured, compound, skull	None			6		1		7
Fracture, simple, cervical vertebrae.	Intraspinal injury			1				1
Fracture, simple, skull	Hemorrhage, intracranial.			1				1
Do	Intracranial injury			2				2
Hemorrhage, traumatic, intracranial.	None			1				1
Injuries, multiple, extreme	None	9		13		5		27
Do	Psychosis, unclassified.			1				1
Intracranial injury	None			2				2
Rupture, traumatic, liver	None			1				1
Wound, gunshot, chest	None			1				1
Wound, gunshot, head	None	2		1				3
Wound, punctured, heart	None			1				1

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DEATHS—Continued

Cause		Navy			Marine Corps		Nurse Corps	Total
Principal	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Injuries and poisonings—Continued								
Poisoning, strychnine, acute	None	-------	-------	-------	-------	1	-------	1
Total for injuries and poisonings.	-------	16	-------	38	-------	9	-------	63
Grand total	-------	20	-------	60	2	13	-------	95
Annual death rate per 1,000:								
All causes	-------	7.88	-------	2.26	5.85	3.02	-------	2.76
Disease only	-------	1.58	-------	.83	5.85	.93	-------	.93
Drowning	-------	1.18	-------	.19	-------	.23	-------	.26
Poisonings	-------	-------	-------	-------	-------	.23	-------	.03
Other injuries	-------	5.12	-------	1.24	-------	1.63	-------	1.54

MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

Statistics for third quarter ending September 30, 1938

The following statistics were taken from sanitary reports submitted by naval training stations:

July, August, and September 1938	Naval training station			
	Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,308	682	732	1,131
Recruits appearing before Board of Medical Survey	18	0	12	(1)
Recruits recommended for discharge from the service	17	0	12	(1)
Recruits discharged by reason of medical survey	9	0	1	(1)
Recruits held over pending further observation	0	0	(1)	(1)
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	12	27	19

[1] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or disease causing the surveys were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

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Cause of survey	Number of surveys
Absence, acquired, teeth	2
Adhesions, abdominal	1
Adhesions, peritoneum	1
Anomaly of form, cervical spine	1
Anomaly of form, urethra, meatus	1
Asthma	1
Astigmatism	7
Caries, teeth	1
Choroiditis	1
Cicatrix, skin	1
Color blindness	2
Constitutional psychopathic inferiority, without psychosis	4
Constitutional psychopathic state, emotional instability	3
Constitutional psychopathic state, inadequate personality	2
Deafness, bilateral	1
Deafness, unilateral	1
Deformity, acquired	3
Dementia praecox	1
Dislocation, chronic, sternoclavicular joint, right	1
Effort syndrome	2
Enuresis	9
Epilepsy	4
Flat foot	25
Foreign body, sole, left foot	1
Fracture, simple, left styloid process (ununited)	1
Gastritis, chronic	1
Gastroptosis	1
Gonococcus infection, urethra	4
Hallux valgus	1
Hay fever	1
Hernia, inguinal	1
Hypertrophy, bone, tibial tubercles	1
Malformation, congenital	2
Malocclusion, teeth	6
Mental deficiency (moron)	1
Myopia, bilateral	1
Myositis, chronic	2
Nephroptosis	1
Neuritis, optic	1
Otitis, media, chronic	3
Perforated membrana tympani	2
Pes cavus	2
Pleurisy, fibrinous, chronic	1
Psychosis, manic depressive	1
Psychoneurosis, hysteria	2
Psychoneurosis, neurasthenia	5
Psychoneurosis, unclassified	1
Somnambulism	3
Union of fracture, faulty	1
Valvular heart disease, combined lesions, aortic and mitral	1
Valvular heart disease, mitral stenosis	1
Valvular heart disease, pulmonic lesions	1
Varicose veins	2

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VOL. XXXVII JULY 1939 No. 3

UNITED STATES NAVAL MEDICAL BULLETIN

FOR THE INFORMATION OF
THE MEDICAL DEPARTMENT OF THE NAVY

DIVISION OF PUBLICATIONS
THE BUREAU OF MEDICINE AND SURGERY

THE MISSION OF THE MEDICAL DEPARTMENT OF THE NAVY

TO KEEP AS MANY MEN AT AS MANY GUNS AS MANY DAYS AS POSSIBLE

Compiled and published under the authority of Naval Appropriation Act for 1938-39, approved April 26, 1938

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

Owing to exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

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Volume XII, 1918, Nos. 1 and 3.
Volume XXIV, 1926, Nos. 1 and 4.
Volume XXV, 1927, No. 1.
Volume XXVII, 1929, Nos. 3 and 4.
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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to the naval medical officer, and reports from various sources, notes, and comments on topics of medical interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of interest to naval medical officers.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Surgeon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T. MCINTIRE,
Surgeon General, United States Navy.

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NOTICE TO CONTRIBUTORS

Contributions to the BULLETIN should be typewritten, double spaced, on plain paper, and should have wide margins. Fasteners which will not tear the paper when removed should be used. Nothing should be written in the manuscript which is not intended for publication. For example, addresses, dates, etc., not a part of the article, require deletion by the editor. The BULLETIN endeavors to follow a uniform style in heading and captions, and the editor can be spared much time and trouble, and unnecessary changes in manuscript can be obviated if authors will follow in these particulars the practice of recent issues.

The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized.

The BULLETIN intends to print only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.

EBEN E. SMITH, *Editor*,
Commander, Medical Corps, United States Navy.

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U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVII JULY 1939 No. 3

SPECIAL ARTICLES

LOSS OF INTERMAXILLARY DISTANCE [1]

EFFECT ON AVIATORS AND RELIEF BY INTERDENTAL SPLINT

By Lt. Raymond A. Lowry, Dental Corps, United States Navy

The study to determine the etiology of certain head conditions which investigators have attributed to abnormalities of the temporomandibular joint is by no means new. Many persons have presented classifications of the anomalies of this joint and the symptoms peculiar to each, or advanced ideas on etiology, diagnosis, and treatment. A few of these contributors are Monson,[2] Prentiss,[3] Wright,[4] Harris,[5] Decker,[6] Costen,[7] Goodfriend,[8] Maves,[9] Riesner,[10] and Gillis.[11]

The teeth, particularly the molars and bicuspids, maintain the intermaxillary distance and with the aid of the muscles of mastication keep the head of the condyle in its normal relation to the glenoid fossa. When there is a shortening of the intermaxillary distance due to the loss of posterior teeth, malocclusion, or occlusal abrasion, certain disturbances of the temporomandibular joint with its ligaments and muscular attachments result. These abnormalities give rise to

[1] From the U. S. Naval Air Station, Pensacola, Fla. Illustrations are from official United States naval photographs. Read before the Tenth International Congress of Military Medicine and Pharmacy, held in Washington, May 7 to 15, 1939.

[2] Monson, G. S.: Occlusion as applied to crown and bridge work. J. A. D. A. 7: 399–413, May 1920.

[3] Prentiss, H. J.: Preliminary report upon temporomandibular articulation in human type. Dental Cosmos 60: 505–514, June 1918; Regional anatomy, emphasizing mandibular movements with specific reference to full denture construction. J. A. D. A. 10: 1085–1099, December 1923.

[4] Wright, W. H.: Deafness as influenced by malposition of jaws. J. A. D. A. 11: 979–982, December 1920.

[5] Harris, H. L.: Anatomy of temporomandibular articulation and adjacent structures. J. A. D. A. 19: 584–590, April 1932; Effect of loss of vertical dimension on anatomic structures of the head and neck. J. A. D. A. and Dental Cosmos 25: 175–193, February 1938.

[6] Decker, J. C.: Traumatic deafness as result of retrusion of condyles of mandible. Ann. Otol., Rhinol. & Laryngol. 34: 519–527, June 1925.

[7] Costen, J. B.: Syndrome of ear and sinus symptoms dependent upon disturbed function of temporomandibular joint. Ann. Otol., Rhinol. & Laryngol., 43: 1–15, March 1934; Some features of the mandibular articulation as it pertains to medical diagnosis, especially in otolaryngology. J. A. D. A. and Dental Cosmos, 24: 1507–1511, September 1937.

[8] Goodfriend, D. J.: Symptomatology and treatment of abnormalities of mandibular articulation. Dental Cosmos, 75: 844–852, September; 947–957, October; 1106–1111 November 1933; Abnormalities of mandibular articulation. J. A. D. A., 21: 204–218, February 1934.

[9] Maves, T. W.: Repositioning of the mandible relation to the temporomandibular joint, correcting cases of subarthrosis and dysarthrosis. J. A. D. A., 22: 763–784, May 1935.

[10] Riesner, S. E.: Temporomandibular articulation: Its consideration in orthodontia diagnosis, Internat. J. Orthodon., 22: 1–28, January 1936.

[11] Gillis, R. R.: Roentgen-ray study of temporomandibular articulation. J. A. D. A. 21: 1321, August 1935.

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the following symptoms: Impaired hearing; stuffy sensation or low buzz in the ears, or a snapping noise in chewing; dull pain within and around the ears; dizziness, either mild or severe; headaches, usually at the vertex, the occiput, or around the ears; a burning sensation in the throat, on the tongue, or the side of the nose; a dry mouth or excessive salivation.[12]

Externally the shortened intermaxillary distance is manifested by changes in the outlines of the lips, and often in those of the chin as well. The lower third of the face becomes shortened, the mouth appears broader, the lips roll outward, the wings of the nose are forced upward and a senile expression results.

When an overbite exists, atrophy of the joint structure also occurs since the condyles are forced upward and backward in the glenoid fossa. Prentiss [3] has pointed out that the anatomic explanation of pain in connection with this condition is fairly simple. Deep erosion of the bone of the glenoid cavity leaves only a thin plate between the condyle and the dura with its rich nerve supply. Thus, pain over the temporal region may originate in irritation of the auriculotemporal nerve from pressure exerted by the condyles in the chewing process. Pains referred to the sides of the tongue may be due to the same pressure on the chorda tympani nerve which passes this spot. The dull vertex pain may also be of dural origin.

Wright [4] and Decker [6] have ascribed certain cases of deafness to the compression of the external canals by the habitual retrusion of the condyles, and trauma to the tympanitic structures from their backward thrust with each closure of the mouth. If these deductions are accepted the conclusion is evident that there would be some type of concussion of the labyrinthine structure or injury to the eighth nerve. In either case recovery of the hearing would necessarily be very slow. That such cases improved in hearing within a few days or weeks after the restoration of normal occlusion, according to Maves,[9] controverts the idea that these ear conditions are due to condylar trauma. He and many others believe that such symptoms are probably due to compression of the eustachian tubes and the resulting inability to equalize intratympanic pressure.

That there is a definite basis for the theory that loss of vertical dimension may cause compression of the eustachian tubes, can be shown anatomically. When the temporomandibular joint is in a normal position, the external pterygoid muscle is taut, the tensor veli palatini muscle borders the tube anteriorally on a straight line and between them lie only connective and adipose tissue. If the mandible is brought upward into a position of overbite, the upper head of the external pterygoid muscle (called the sphenomeniscus muscle by

[12] Higley, L. B.: Practical application of a new scientific method of producing temporomandibular roentgenograms. J. A. D. A. & Dental Cosmos, 24: 222-230, February 1937.

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Prentiss) is relaxed and a bundle of soft tissue piles against the tube, causing compression; the tensor veli palatini muscle becomes loose and is thereby prevented from performing its function of tightening the soft palate and opening the eustachian tube during deglutition.

The very looseness of the capsule of the mandibular joint and its restraining ligaments now works to further exaggerate the pushing of tissues toward the tube, so that the compressing effect of these tissues on the tube from the overbite prevents it from being opened by the tensor veli palatini muscle.

Costen,[13] in arriving at his deductions as to the behavior of the tissues bordering the tube during overclosure, simulated that condition in a soft-tissue specimen. A portion of his report follows:

> When this is done manually (to imitate similar overclosure in life), the tensor veli palatini muscle bordering the membranous anterior edge of the tube and the adjacent spheno-meniscus muscle are seen to wrinkle and crowd the eustachian tube, closing it firmly. During the act of swallowing the tensor veli palatini muscle should be tense and effect a temporary opening of the tube. This function cannot occur during overclosure, and the result is derangement of intratympanic pressure * * *.

Both Monson [14] and Smith [15] have reported that overclosure lessens the area available for the tongue, which, being forced back, assumes a position that impairs its function in swallowing and crowds upon all adjacent tissues, lessening their functions. Evidence indicates that the crowding of these tissues reduces the size of the air passages and causes lack of drainage of all parts affected by the tongue, especially the eustachian tubes.

The function of the eustachian tube is to drain and ventilate the middle ear. The motion of the cilia and the valve-like action of the tube favor passage of material from the ear to the nasopharynx and prevent motion in the opposite direction. The tube, normally closed, is opened by the contraction of its dilator muscles, and at such times any air pressure differential existing between the middle ear and the atmosphere is equalized. This opening may be accomplished in normal individuals by swallowing, yawning, singing, autoinflation, or by contracting the salpingopharyngeal muscles. This last named is difficult to describe, but, according to Armstrong,[16] can be learned by practicing the suppression of a simulated yawn.

Rich [17] has pointed out that the tympanic membrane functions perfectly only when the atmospheric pressure is the same in the tym-

[13] Costen, J. B.: J. A. M. A., **107**: 252–255, July 25, 1936.

[14] Monson, G. S.: Impaired function as a result of closed bite. J. N. D. A., **8**: October 1921.

[15] Smith, Tom: Review of literature on eustachian tube, with data indicating a relation to dental occlusion. J. A. D. A. **12**: 671–681, June 1925.

[16] Armstrong, H. G. and Heim, J. W.: Effect of flight on the middle ear. J. A. M. A., **109**: 417–421, August 7, 1937.

[17] Rich, A. R.: A Pathological study of the eustachian tube and its related muscles. Bulletin Johns Hopkins Hospital, **30**: 206, June 1920.

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panic cavity as in the external auditory canal. Severe pain may be caused by the bulging and stretching of the membrane which result from inequality in pressure. Such pressure may even be sufficient to rupture the membrane. In any event, its vibratory function is impaired until pressure equilibrium is restored by the inflow of atmospheric air from the nasopharnyx through the eustachian tube into the tympanic cavity.

The relation of malposition of the mandible to stenosis of the eustachian tubes was first applied to aviation by Willhelmy.[18] This investigator noticed that six aviation pilots having malocclusion showed distressing ear symptoms when experiencing sudden losses of altitude. He reported that each of the six cases was entirely relieved of these symptoms after the mandible had been repositioned so as to increase the vertical dimension and presumably relieve the pressure on the eustachian tubes.

Armstrong [16] reported that while experimenting with varying atmospheric pressures he found that when pressure was decreased, as in ascending, the subjective symptom was a feeling of fullness in the ears. This was partially relieved at intervals, accompanied by a sudden annoying click which he explained by saying that the eustachian tube had been forced open by the excess pressure in the tympanic cavity and relief afforded by a sudden rush of air from the ear to the nasopharynx. When, however, a descent was simulated by increasing the pressure (and the subjects cautioned against voluntary efforts to open the eustachian tubes) the tubes acted as flutter valves and remained closed under all degrees of pressure.

In subsequent tests he found that opening the eustachian tubes by voluntary effort effected immediate equalization in the air pressure, except that it was impossible for them to open and overcome the negative pressure after a pressure of 80 to 90 mm. of mercury had developed. In this case it was necessary to decrease the atmospheric pressure below that point, or in other words to return to a higher altitude, to allow voluntary opening.

In descents a small amount of negative pressure affects most individuals by producing a feeling of fullness in the middle ear. With increased pressure this discomfort is more evident, and sounds seem distant and of lesser intensity. With more pressure the feeling of fullness is increased and may be accompanied by tinnitis of a hissing, roaring, snapping, or crackling character. In some individuals there may be pain and vertigo of a mild nature. Increasing pressure produces increasing pain which often resembles that of acute otitis media. Tinnitis is more pronounced and there is usually vertigo with incipient nausea. At negative pressures of from 60 to 80 mm. of mercury the

[18] Willhelmy, G. E.: Ear symptoms incidental to sudden altitude changes and the factor of overclosure of the mandible—preliminary report. U. S. Naval Medical Bulletin, 34: 533–541, 1936.

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pain is severe and radiates from the ear to the temporal region, the parotid gland, and the cheek. Still greater pressure produces agonizing pain, which seems to be localized in the parotid gland. Deafness and vertigo usually increase and tinnitis either increases or disappears. At pressure above 100 mm. of mercury the membrane ruptures.

Armstrong [16] has remarked that since the average person swallows involuntarily about every 60 to 75 seconds, a rate of climb or descent of 200 feet per minute will usually cause no discomfort. A rate of 1,000 feet per minute will be only mildly disagreeable, even though no attempt is made to equalize the pressure artificially. Descents above 4,000 feet per minute might catch an individual unawares and create a tympanic vacuum which could be relieved only by returning to a higher altitude. A simple explanation of how to ventilate the tympanum, and how frequently, should suffice in normal individuals. Therefore, as long as the patency of the eustachian tube is under voluntary control, there is no reason why any person in command of his faculties should experience difficulty at any rate of ascent or descent in present commercial aircraft.

Inability to voluntarily open the eustachian tube may be attributed to any of several causes. A few are as follows: Acute and chronic infections of the upper respiratory tract, nasal obstruction, sinusitis, tonsillitis, tumors and growths of the nose and nasopharynx, paralysis of the soft palate or superior pharyngeal muscles, enlargement of the pharyngeal or tubal tonsil, inflammatory conditions of the eustachian tube or middle ear, scar tissue about the ostium of the eustachian tube following adenectomy, and malposition of the jaws.[16]

Rigid service-entrance requirements and thorough periodic examinations of flight personnel rule out most of the foregoing causes of eustachian stenosis. Consequently it was with the last named in mind that a study was begun to determine the incidence of this condition. It was also proposed that treatment be given in as many cases as possible by repositioning the mandible and restoring the vertical dimension, to learn how much it would add to the comfort while flying.

Conference with the flight surgeons at two activities disclosed the fact that distressing ear symptoms which might be attributed to loss in vertical dimension, were not nearly as prevalent as had been anticipated. In any event, the personnel had reported none, perhaps regarding them as being one of the natural inconveniences incident to flying.

Accordingly a survey was begun by examining the entire flight personnel at these activities. In each case the person's age and the number of years he had been associated with control of aircraft was listed. His remaining teeth were carefully charted, the amount of

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occlusal abrasion estimated, and the type of occlusion noted. The amount of loss, if any, in vertical dimension was estimated, using both the measurements described in Crawford's [19] article, and the method of palpating the heads of the condyles advocated by Monson.[20] Each health record was examined and the patient questioned as to subjective symptoms which might be caused by faulty ventilation of the tympanum. In cases where all other causative factors had been ruled out by examination and reference to flight physical examinations, corrective appliances were constructed.

Of the entire number of 540 aviators, 83 or 15.3 percent were found to have losses in vertical dimension. Thirty-three, or 39.7 percent of the 83 persons with loss of vertical dimension, gave histories of faulty ventilation of the tympanum; this was 6.1 percent of all those examined. Loss in vertical dimension in these 33 persons was found to be due to malocclusion in 5 cases, to occlusal abrasion in 12 cases, and to a combination of malocclusion and occlusal abrasion in the remaining 16. See table 1 for a detailed tabulation of the physical findings in these cases.

TABLE 1

Cause of vertical dimension loss, 33 cases with symptoms

Case No.	Age	Abrasion	Occlusion	Missing teeth
20	32	+	Deep overbite	1-16-17-32.
21	30	+	Class II	16-17.
28	33	−	Deep overbite	16-17-19-32.
30	30	+	do	19-30.
34	43	+	Class I	3-8-12-14-16-17-18-19-30-31.
37	40	+	do	3-19.
70	31	+	Deep overbite	1-3-19-30.
86	32	+	Class III	1-16-32.
98	32	+	Class I	0.
121	30	+	Deep overbite	0.
124	30	−	do	3-4-7-12-14-16-17-18-19-30.
125	33	+	Class III	14.
133	42	+	Class I	19.
140	31	+	Class III	4-14-15-20-30.
189	30	+	Class I	4-17.
194	38	+	Class II	3-6-7-8-9-10-11-14-19-30.
100N	27	+	Class I	1-17-32.
101N	24	+	do	0.
102N	24	−	Class II	1-12-16-19-30.
103N	28	+	do	1-16-17-32.
104N	23	+	do	1-13-16-19-30.
105N	34	+	do	1-32.
106N	28	−	Deep overbite	24.
107N	24	+	Class I	1-19-30-32.
108N	26	+	do	1-16.
109N	24	+	Class II	1-12-16-17-19-29-30.
110N	32	+	Class I	1-17-19-30.
111N	40	+	do	15-17-19-30-32.
112N	35	+	Deep overbite	1-12-16-32.
113N	42	+	Class I	1-17-32.
114N	35	+	Deep overbite	1-16-17-32.
115N	27	+	do	0.
116N	29	−	do	1-16-17-32.

[19] Crawford, J. W.: Restoration of lost facial dimensions and facial harmony. J. A. D. A. **21**: 664-671, April 1934.

[20] Monson, G. S.: Determining condyle position. J. N. D. A. 1921.

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These men, whose ages ranged from 22 to 49 years, had been associated with actual control of aircraft for from 1 to 23 years. It is believed that they represent a good cross-section of service aviation personnel. They were examined in three groups: Student aviators, aviation personnel engaged in squadron activities, and instructors. See chart 1.

The student group contained 99 persons, whose average age was 26 years, and whose average flying experience was 1 year. Of this number 10, or 10 percent, had losses in vertical dimension but none gave a history of ear symptoms.

The personnel of the second group averaged 29 years of age and had an average of 5 years, 5 months flying experience. These men were engaged in squadron exercises where they encountered greater and more rapid changes in air pressures. Of 245 examined in this group, 31, or 12.6 percent, were found to have losses in vertical dimension. Seventeen, or 54.8 percent of these (6.9 percent of the entire group), admitted of symptoms that might be associated with delayed or faulty ventilation of the tympanum.

The instructor group numbered 196. Their average age was 33; their average flying time 8 years. Of these 42, or 21.4 percent, had losses in vertical dimension, and 16, or 38 percent, gave histories of subjective symptoms. Eight percent of all the instructors examined admitted of discomfort during varying pressures incident to flying.

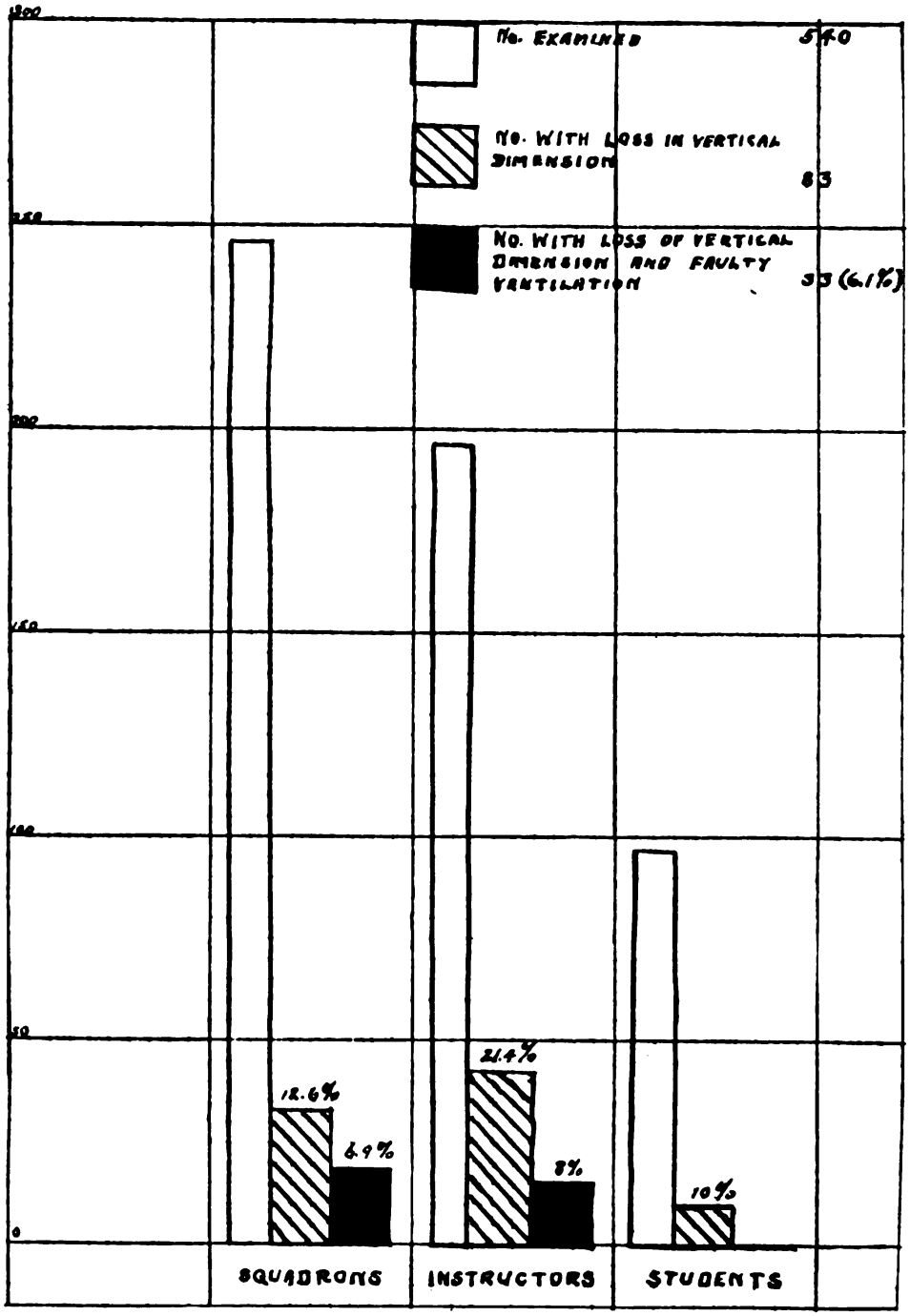
As it might be expected, the older group, the instructors, had a higher incidence of loss in vertical dimension. This was due to a greater degree of occlusal abrasion, and to loss of a larger number of teeth. However, in regard to the total number of persons with overclosure of the mandible, there was a higher percentage in the squadron personnel giving histories of subjective symptoms. This was natural since instructors and students limit their activities to altitudes not exceeding 5,000 feet.

The 33 cases with loss in vertical dimension gave histories of the following symptoms: Discomfort and inability to readily equalize pressure on the tympanum, pain, tinnitis, and impaired hearing. None of this group gave a history of vertigo associated with change in altitude. The incidence of these symptoms is reported in table 2.

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CHART 1

Incidence of loss of vertical dimension and faulty ventilation



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TABLE 2

Incidence of symptoms

Case No.	Faulty ventilation	Pain	Tinnitis	Deafness	Vertigo
20	+	+	+	−	−
21	+	+	+	+	−
28	+	−	+	−	−
30	+	+	+	−	−
34	−	−	+	+	−
37	+	−	−	+	−
70	−	−	+	−	−
86	+	+	−	−	−
98	−	+	+	+	−
121	−	+	+	−	−
124	+	+	−	−	−
125	−	+	−	+	−
133	+	+	−	−	−
140	−	+	−	−	−
189	+	−	−	+	−
194	+	+	+	−	−
100N	+	+	−	−	−
101N	+	−	+	−	−
102N	+	+	+	−	−
103N	+	+	−	−	−
104N	+	−	+	−	−
105N	+	+	+	−	−
106N	+	+	+	−	−
107N	+	+	−	−	−
108N	+	+	+	−	−
109N	+	−	−	+	−
110N	+	+	−	−	−
111N	+	+	−	−	−
112N	+	−	+	−	−
113N	+	−	+	−	−
114N	+	+	−	−	−
115N	+	+	+	−	−
116N	+	+	−	−	−
Total	27	23	18	7	0

Corrective appliances were constructed for 31 individuals of this group (2 persons did not wish them). An effort was made to embrace the best features of several methods that have been reported in dental literature. In order that interdental splints of this type could be made at any prosthetic dental activity, only materials furnished on the supply table were used. Inasmuch as patients were reluctant to have splints cemented to the teeth for this experiment, removable appliances were decided upon. This permitted proper oral hygiene to be practiced, and did not injure the teeth or investing structures. The appliances were reported to be very stable since the points of greatest convexity were covered on both the lingual and buccal surfaces by the interdental splints. Their relative size precluded the possibility of their being swallowed, and for this reason they were believed to be superior to other types of appliances which utilize from 2 to 4 sections.

The method of construction was as follows:

1. Accurate impressions were obtained, using elastic impression compound; models were then made of dental stone.

2. Face bow registrations were taken and the upper cast mounted on an anatomical articulator. The lower cast was mounted (see fig. 1) using as a guide

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the sulci and inclined planes of the opposing teeth. When there were not sufficient teeth remaining for this purpose, a bite in centric occlusion was used.

3. With the aid of protrusive registrations in soft wax, the angles of the condylar guidance were determined. This was done so that excursions of the mandible could be simulated on the articulator.

4. Lateral excursions were verified from the mouth by using registrations secured from the working and balanced bites.

5. The vertical dimension was next increased on the articulator by lowering the incisal pin to the point where there was no cuspal interference of the opposing teeth in lateral excursions. (See fig. 2.)

6. Softened wax was interposed between the teeth on the articulator, and chilled. (See fig. 3.) This trial opened bite was returned to the mouth and checked for restoration of facial dimension.

7. The buccal and lingual surfaces of the lower posterior teeth were covered with one thickness of base-plate wax. The interproximal spaces were carved to give more comfort to the wearer. (See figs. 4 and 5.) Softened wax was added to the occlusal surfaces, the articulator closed, and lateral and protrusive excursions simulated. The occlusal portion was then trimmed and smoothed so that there were no deep indentations to influence the closed relation, yet contact at any eccentric motion of the mandible was allowed. The two sections were connected by flowing wax over the lingual surfaces of the incisors.

8. The case was flasked, packed against cellophane, vulcanized, and polished. (See fig. 6 for completed splint.)

9. After insertion into the mouth, great care was taken to obtain balanced occlusion. At this time any points of interference were ground off.

Those persons supplied with interdental splints were directed to wear them as much as possible so as to become accustomed to them and possibly obtain beneficial results through better ventilation before testing them in actual flight. Later the splints were worn during flying conditions known to cause discomfort. The results were tabulated by the individual aviator. As a control each subject was instructed to follow the same maneuver with and without the splint. After adequate tests each was asked to submit a written report embodying the following items:

1. A brief description of tests made giving altitude changes and speed.
2. A statement as to whether the ear symptoms were entirely absent, partially absent, or still present.
3. A statement as to comfort to the mouth.
4. Any other pertinent remarks or suggestions.

Twenty-six persons, after intervening periods of from 6 months to 1 year, submitted written reports as to the effectiveness of the interdental splints. Five persons submitted no reports.

It should be remembered that these results were based solely on subjective symptoms, hence the personal factor must be taken into consideration.

The reports from this number were as follows: 9 persons were apparently relieved of all distressing ear symptoms, 14 were benefited by its use, 3 derived no beneficial results. When these figures are converted to percentages they show 34.6 percent had symptoms

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eliminated, 53.8 percent alleviated, and 11.5 percent reported no improvement.

The 26 cases from whom reports were received had losses in vertical dimension because of the following: Malocclusion only, 4; occlusal abrasion only, 9; a combination of malocclusion and occlusal abrasion, 13. The 17 cases of malocclusion included 7 with deep overbites described by Mershon,[21] 7 Angle's class II, and 3 Angle's class III.

It was not proposed in this report to discuss the relative advantages and disadvantages of restoring lost facial dimension, but to report results as they were found in a cross section of aviation personnel who had loss in vertical dimension and apparently had difficulty in equalizing intratympanic pressure during changes in altitude.

Dental literature abounds in articles advocating the opening of bites and the restoring of lost facial dimension. A few of these advocates are mentioned here: Costen,[7] Maves,[9] Goodfriend,[8] Bailey,[22] and Edmond.[23] Recently a number of articles have appeared which condemn the practice and warn of its possibilities and limitations, notably, Mershon,[21] Tench,[24] Trattner,[25] Batson,[26] and Anthony.[27]

SUMMARY

While the number and variety of symptoms reported in medicodental literature to be due to malocclusion are constantly increasing, attention is again being focussed on procedures for remedying the inevitable closing of the bite.

In the light of present research, it is believed that loss of vertical dimension with its resultant disturbance of the temporomandibular joint, its ligaments and muscular attachments, causes stenosis of the eustachian tubes. The relaxation of certain muscles allows soft tissues to compress the tubes; the looseness of others prevents the performance of their function of elevating the soft palate and opening the tubes during deglutition.

During the rapid changes of pressure commonly occurring in airplane flights, proper ventilation of the middle ear is essential, lest a

[21] Mershon, J. F.: Possibilities and limitations in the treatment of closed bites. The New York Journal of Dentistry, 7: 185–191. June 1937.

[22] Bailey, E. E.: Repositioning the mandible. J. A. D. A. and Dental Cosmos, 24: 33–50, January 1937.

[23] Edmond, P. A.: Restoring lost vertical dimension. J. A. D. A. and Dental Cosmos, 25: 849–860, June 1938.

[24] Tench, R. W.: Dangers in dental reconstruction involving increase in the vertical dimension of the lower third of the human face. J. A. D. A. and Dental Cosmos, 25: 566–570, April 1938.

[25] Trattner, H.: Bite raising and attendant dangers. New York Journal of Dentistry, 7: 23–24, January 1937.

[26] Batson, O. V.: The closed bite and related clinical problems. J. A. D. A. and Dental Cosmos, 25: 175–193, February 1938.

[27] Anthony, L. P.: Editorial: Opening the bite. J. A. D. A. 25: 954–956, June 1938.

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difference in air pressure between the air in the tympanic cavity and the surrounding atmosphere develop. Such an inequality of pressure causes the tympanic membrane to stretch and bulge, and gives rise to discomfort, pain, tinnitis, or impaired hearing.

It has been noticed in persons who are unable to voluntarily open their eustachian tubes that the greatest discomfort is experienced while descending rapidly. This is probably due to the fact that the ostium of the tube acts as a flutter valve, opening to internal pressure only. Ability to open the tubes voluntarily is absolutely necessary to effect immediate equalization of pressure and restoration of the tympanic membrane to its normal position.

The relation of malposition of the mandible to stenosis of the eustachian tubes was first applied to aviation by Willhelmy.[18] He reported that six cases were entirely relieved of ear symptoms attributed to improper ventilation of the tympanum after the mandible had been repositioned so as to restore lost vertical dimension.

Examination of 540 aviators disclosed that 33, or 39.7 percent of those suspected of having faulty ventilation of the tympanum, admitted of symptoms. This number (33) represents 6.1 percent of all those examined.

Of 26 cases treated by restoring lost intermaxillary distance with the aid of dental splints, 34.6 percent reported that all symptoms were apparently eliminated; 53.8 percent were benefited and preferred to use the splint during flights; 12 percent were unaided.

The most common causes of loss of verticle dimension were: Occlusal abrasion, malocclusion, and loss of posterior teeth. Of the 26 cases which were treated, 4 had loss of intermaxillary distance due to malocclusion only, 9 due to occlusal abrasion only, and 13 due to a combination of malocclusion and occlusal abrasion. It should be noted that 65 percent of this group had some form of malocclusion.

Although these results are based solely on subjective symptoms and the personal factor must consequently be taken into consideration, it would appear that flying can be made more comfortable, at least in certain cases, by restoring the vertical dimension to normal since 89 percent of those treated were aided.

As a result of these findings, it is believed that, although loss of intermaxillary distance accompanied by faulty ventilation of the tympanum is not as common among service aviators as had been supposed, nevertheless the greatest care should be taken in making restorations of all types for aviation personnel. More attention also might well be devoted to malocclusion and loss of vertical dimension in determining whether or not applicants are to be selected for aviation pilots.

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CASE REPORTS

Case 70.—C. C. D., age 31, had been flying 10 years.

The patient had a class II Angle's occlusion, with teeth numbers 1, 3, 19, and 30 missing. There was occlusal abrasion, with a loss in vertical dimension. The motion of the condyles was normal and the hearing was classified at 15/15 in each ear.

This patient was an instructor and gave a history of tinnitus and ringing in the ears after prolonged flights.

The vertical dimension was increased 4 millimeters with the aid of a corrective appliance.

The patient's own statement is quoted here:

1. I have been using the dental splint you made for me for a period of about 30 days, doing about 10 hours of miscellaneous flying at altitudes averaging about 3,000 feet. While the splint does not entirely eliminate differential pressure in my ears, I definitely prefer wearing it. During the time the splint was being made, I made several extended flights, carrying a pencil between my teeth, as you suggested until the splint was made. I credit this as being responsible for complete absence of ringing of the ears, which I formerly experienced after long flights.

2. The splint has become a fixed item of my flying equipment and I expect to continue to use it.

NOTE.—A month after the above report was submitted, the patient reported one instance of a descent from 18,000 feet, with no discomfort resulting.

Case 98.—P. J. A., age 32, had been flying 9 years. All the teeth were present and there was a class I Angle's occlusion. There was occlusal abrasion with a resulting loss in vertical dimension of 2 millimeters. Motion of the condyles was normal. Hearing was classified as 15/15 in each ear. The patient had a history of chronically infected tonsils.

This patient served as an instructor and gave a history of tinnitus and pain in the ears upon change in altitude.

The vertical dimension was increased 2 millimeters.

The patient's own report is as follows:

I am pleased to inform you that your appliance for equalizing pressure in the ear during flight has proven satisfactory to me. I happened to have a head cold, when experimenting with it, and found that, after flights when I didn't use it, I couldn't hear well for 20 minutes to a half hour after landing, with the usual discomfort of pain and "crackling" in the ears. However, on those flights when I did use it, I felt perfectly normal, with no discomfort, immediately upon landing. I anticipate using this as a part of my flight equipment in the future and I heartily thank you for your efforts in its construction.

Case 125.—S. D. A., age 33, had been flying 7 years. The patient had a class III Angle's occlusion with tooth number 14 missing. There was slight occlusal abrasion and a loss of vertical dimension. The movement of the condyles appeared normal and hearing was classified as 15/15 for each ear.

The patient was formerly an instructor, but is now flying commercially. He gave a history of pains in the ears (approximately 3 minutes in duration) when altitude change was very rapid.

With the aid of a corrective appliance the vertical dimension in this case was increased 2 millimeters.

At the end of 2½ months the patient reported as follows:

A few days ago I managed to get down to the United States Naval Reserve Air Base at Long Beach to run some tests. I made several rapid descents * * * from 12,000 feet, landing immediately and experienced no discomfort

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whatsoever. I then made several prolonged descents losing altitude at 600 to 800 feet per minute. I believe this rate of descent is sometimes more annoying to pilots than a rapid descent, so that I find the "bite" works 100 percent in my case and it is my belief that it is the answer for any pilot that experiences ear discomfort on dives.

Practically by accident, I discovered another extremely valuable use for the "bite." Airline pilots all agree that when "letting down through" on radio-range beam they are not able to have the volume turned down to a minimum where it should be, due to the ears not clearing rapidly enough. This excessive volume causes a broad wave and interference, causing misleading signals at times when approaching the cone of silence. I found that with the use of the "bite" this condition can be entirely eliminated and beam signals received with a minimum volume, making for a much more accurate instrument approach on a station * * *.

Case N-110.—S. C., had been flying for 9 years and had had 2,600 hours. There was a class I Angle's occlusion and teeth numbers 1, 17, 19, and 30 were missing. Occlusal abrasion was slight. The condyles had some posterior motion on closing and there was a loss in vertical dimension. The tonsils had been removed, and the nasopharynx was normal. The right membrani tympani was scarred. The patient complained of pain in and about the ears and frontal sinuses when making steep dives.

The vertical dimension was increased 3 millimeters with the aid of an appliance.

The following report was received after 4 months:

Terminal velocity dive tests were made with a fighting plane * * * over an altitude change from approximately 14,000 feet to 5,000–7,000 feet.

On the first dive I had forgotten my interdental splint and experienced severe pains through the central part of my head as well as across my face beneath the eyes. Swallowing, biting, yelling, or bumping my head had no appreciable effect in reducing the pain. I finally climbed back to a higher altitude which helped a little, then slowly descended and obtained the splint.

During subsequent dives with the splint under the same speed and altitude conditions as above, I was able to greatly diminish the pain through my head by merely biting down on the splint and holding it throughout the dive. This did not completely eliminate the pain, but it reduced to minor proportions. It did not have much effect upon the pain that I felt across my face and beneath my eyes. In the sinus area I believe. Nothing that I did diminished that particular pain with the exception of climbing back to higher altitudes.

On one dive I waited until the pain in my head started before I bit down on the splint. As I remember, there was a distinct click and an immediate relief from the pain that was starting.

In general and judging from my brief experience with the interdental splint, I am heartily in favor of it and feel that it is the best thing devised to date to relieve the pressure and pain that one experiences in the head during a high-speed dive * * *.

ANALYSIS OF DENTAL ABNORMALITIES

FOUND ON ANNUAL PHYSICAL EXAMINATION OF OFFICERS

By Commander Walter Rehrauer, Dental Corps, United States Navy

The dental portion of the annual physical examination of 84 officers was made in the dental office of the U. S. S. *Saratoga* during the month of December 1938. Of these, 67 were commissioned officers and 17 were warrant officers.

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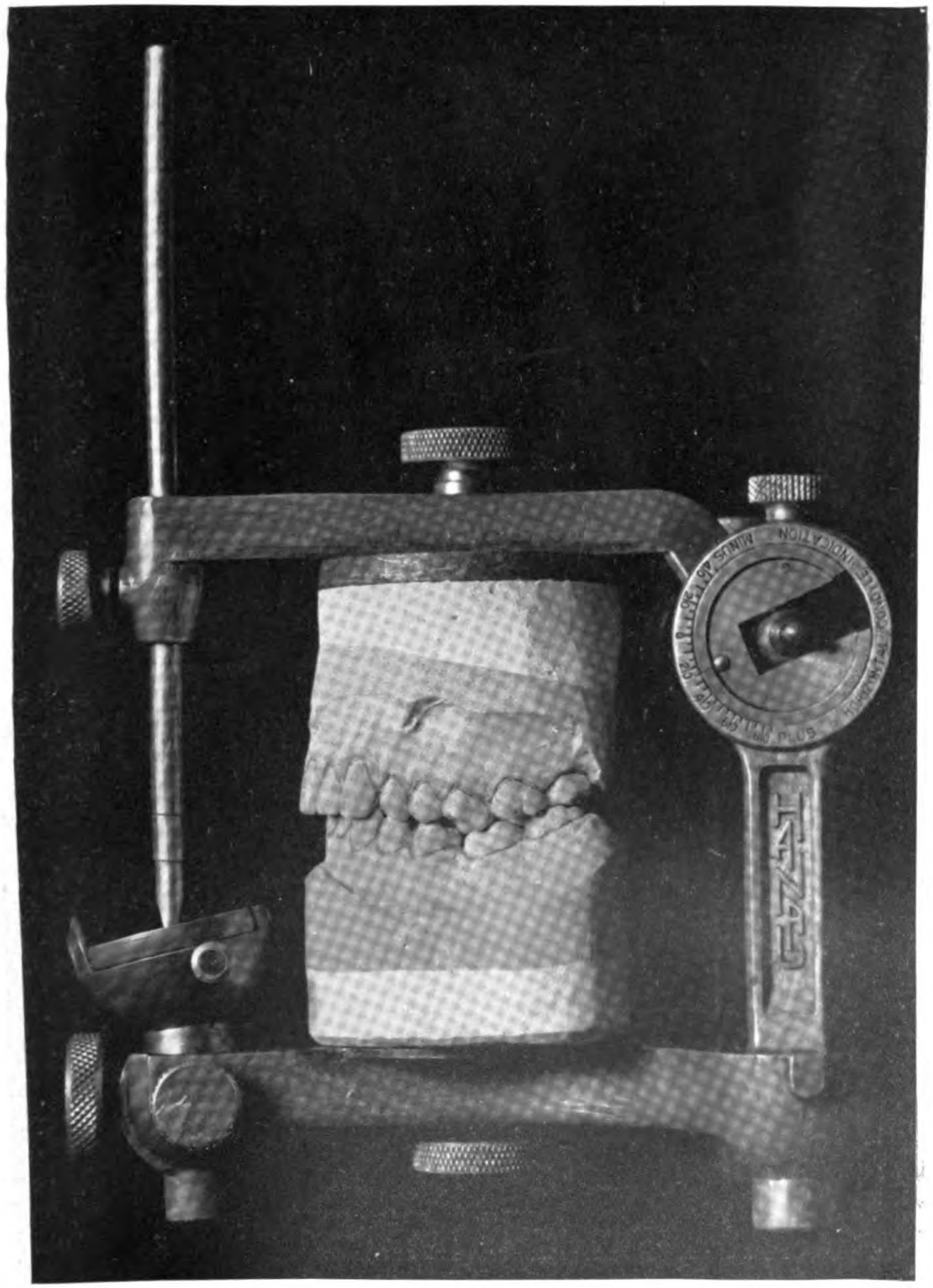


FIGURE 1.

Anatomical articulator with mounted casts.

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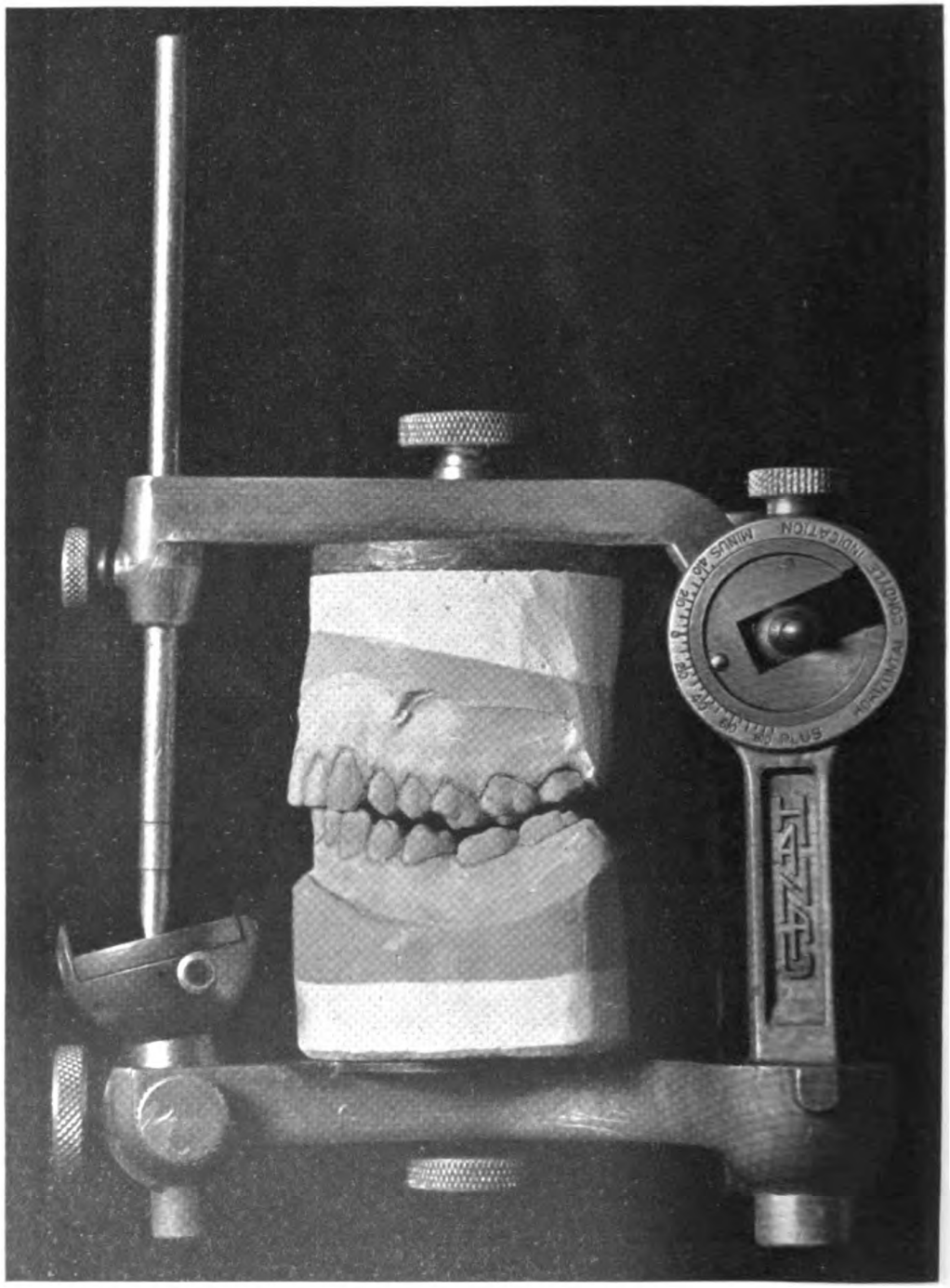


FIGURE 2.

Vertical dimension increased proper distance.

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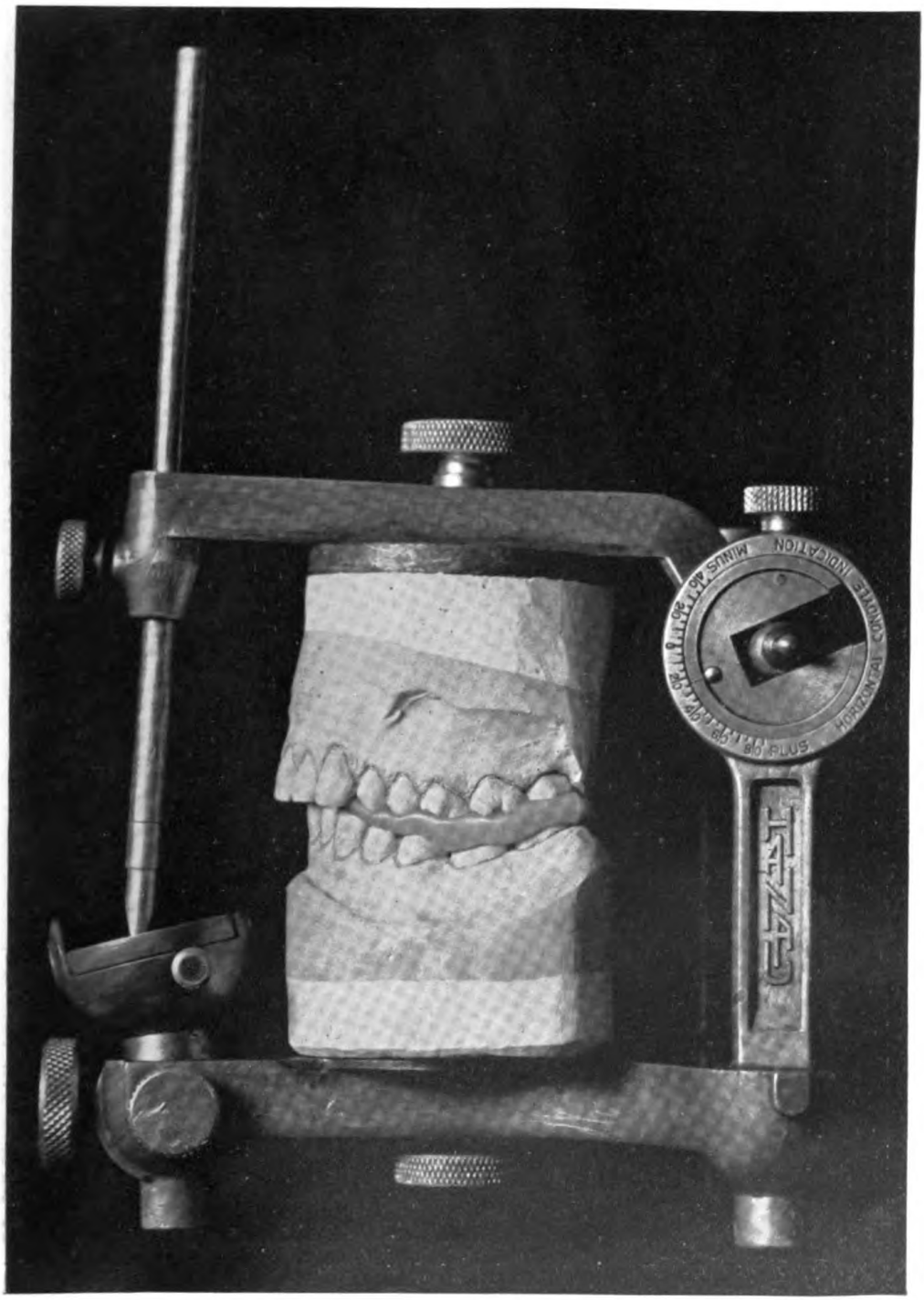


FIGURE 3.
Wax interposed between teeth.

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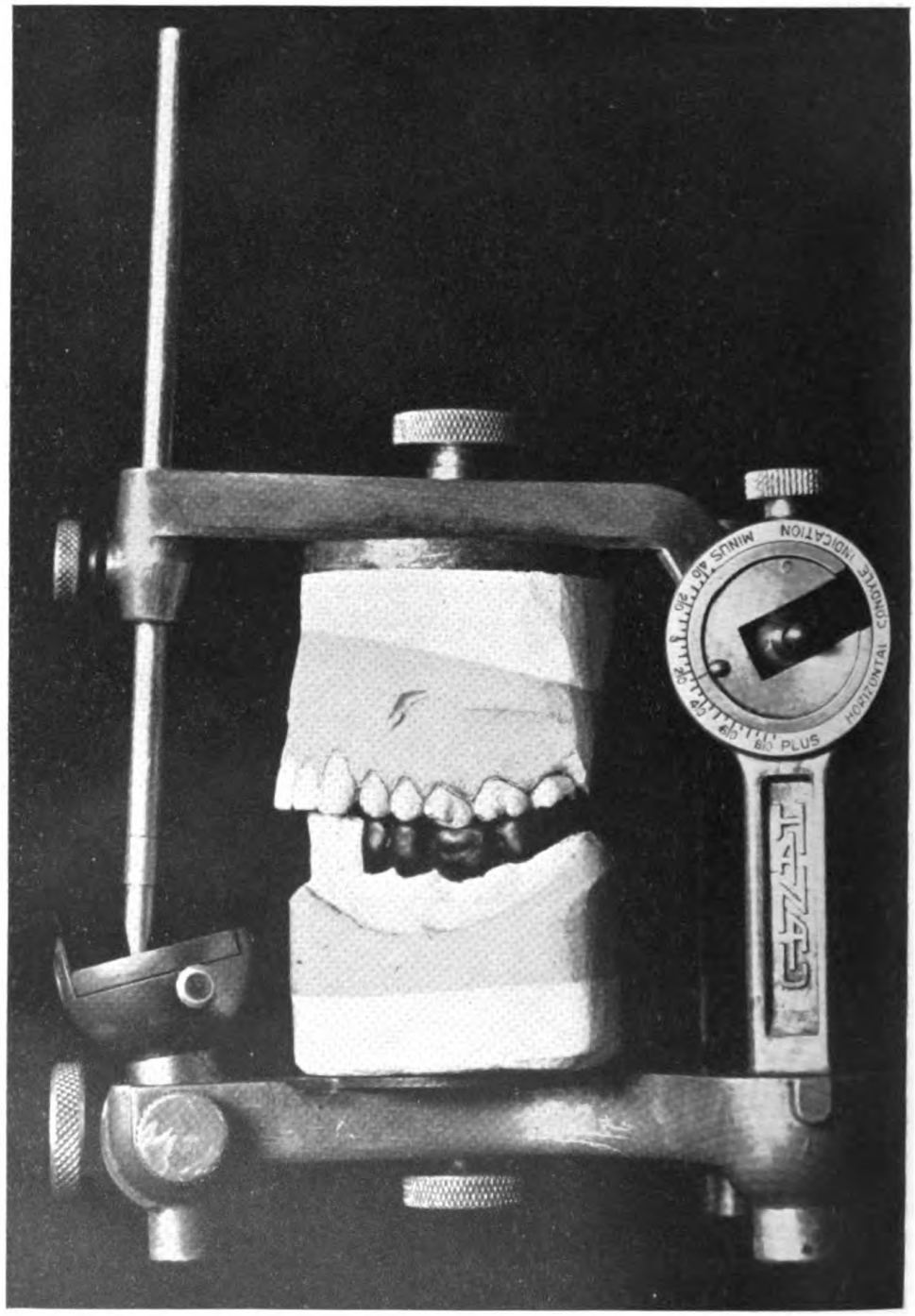


FIGURE 4.
Lateral view of splint

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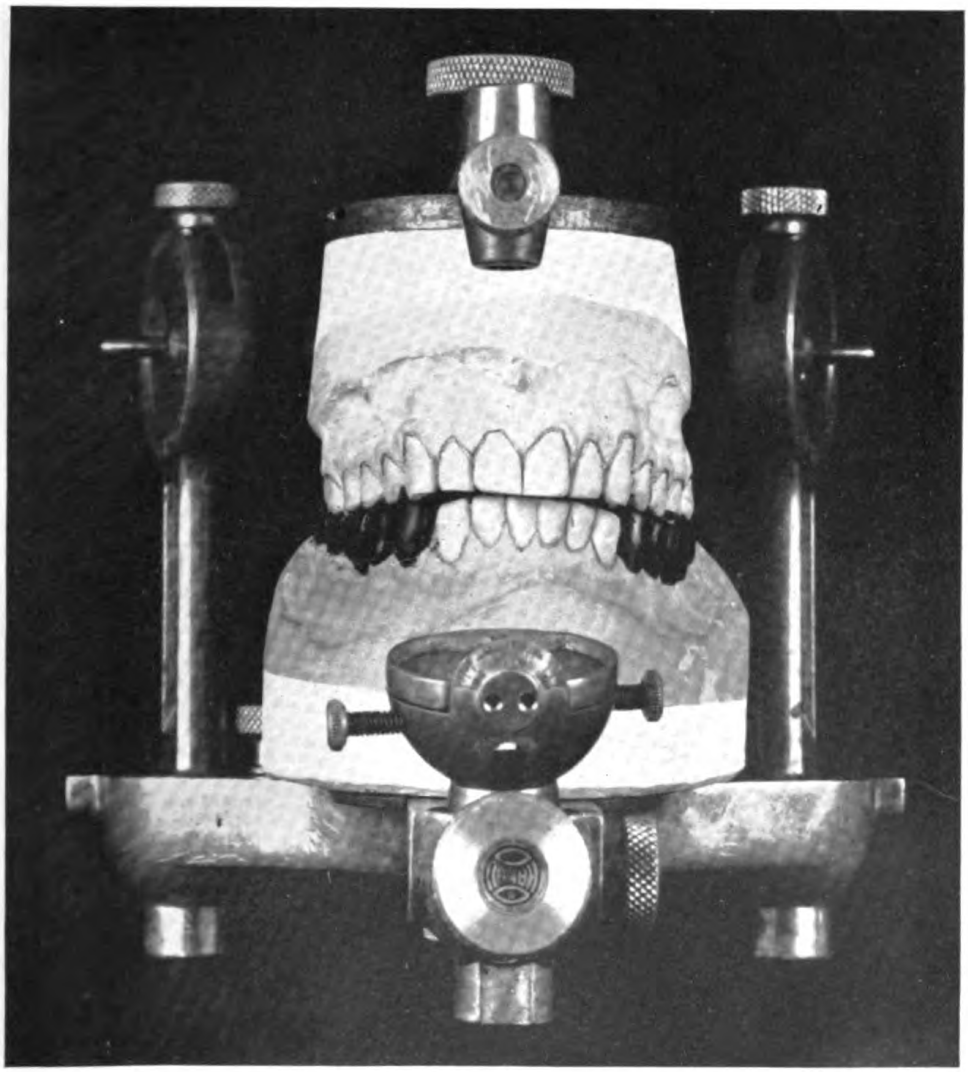


FIGURE 5.
Anterior view of splint.

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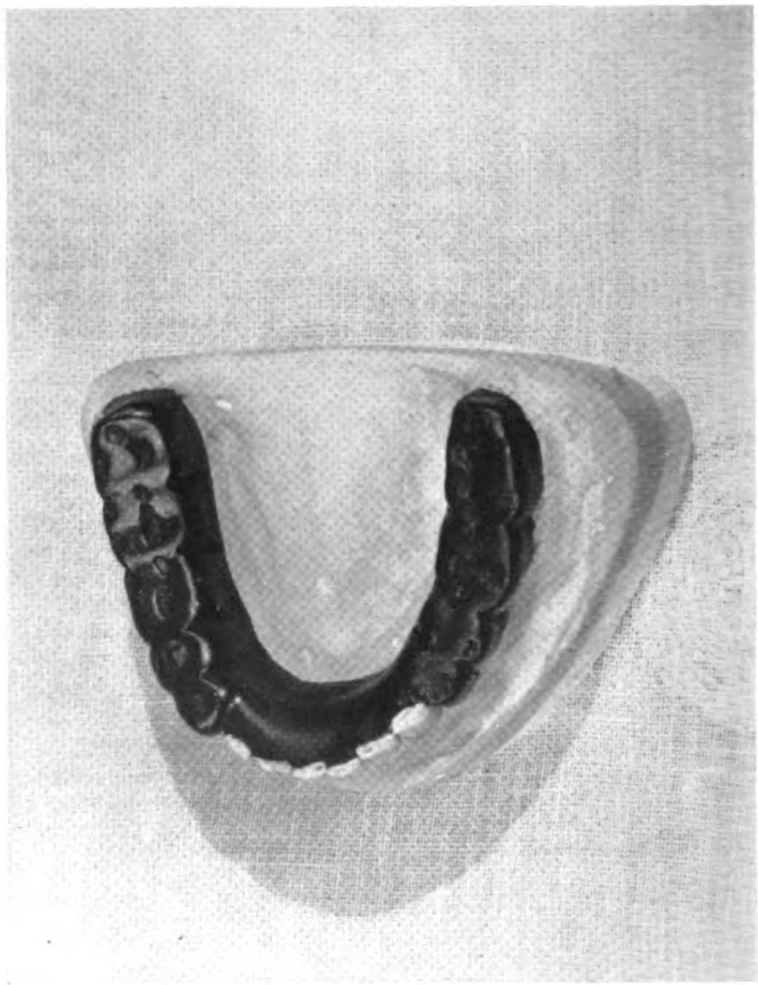


FIGURE 6.
Vertical view of splint.

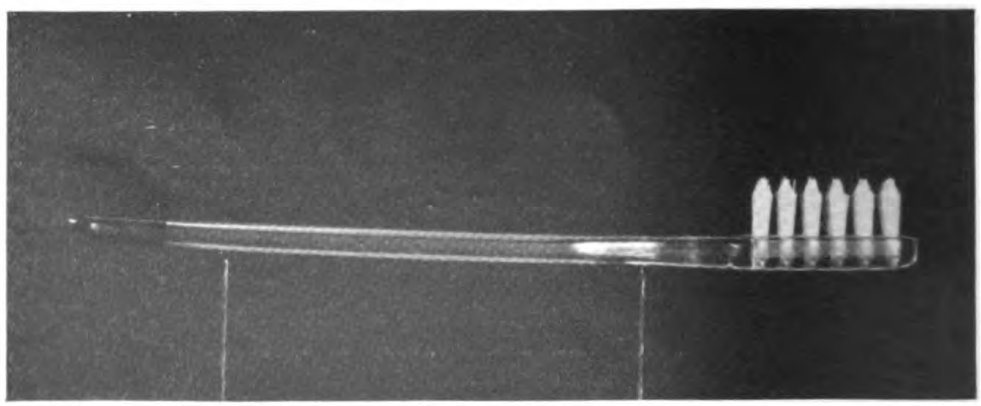


FIGURE 7.
Satisfactory type of tooth brush, *see page 384.*

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METHOD OF MAKING THE EXAMINATIONS

These examinations were very carefully made. A full mouth series of dental roentgenograms was made for each officer for the purpose of assisting in locating oral foci of infection, nonvital teeth, periapical disease, impacted teeth, cysts, overhanging gingivo-approximal filling margins and excessive resorption of interapproximal alveolar crests. It was found that these roentgenograms disclosed many carious areas in the approximal surfaces of the teeth, numerous overhanging fillings into the approximal spaces, and much advanced alveolar resorption which could not be found by visual or clinical means. Each full-mouth series consisted of ten 1¼- by 1⅝-inch films. It is realized that this number of exposures is not the ideal number for a full-mouth examination but it is considered to be sufficient for the purpose intended because a full-mouth series of bite-wing roentgenograms, consisting of five films (2 type 3 posterior and 3 type 1 anterior) were also made in each case. The bite-wing roentgenograms were made for the purpose of locating carious areas in the approximal surfaces of the teeth, overhanging filling margins involving the gingivo-approximal surfaces, and excessive resorption of the approximal crests of the alveolar process not found with the 1¼- by 1⅝-inch films. In making the examinations from the roentgenograms, the full-mouth, 10-exposure series of 1¼- by 1⅝-inch films were first studied and the findings recorded. The bite-wings were then read and the caries and pathology were recorded that had not been found by either visual or clinical means or with the 1¼- by 1⅝-inch films. By making these two series of roentgenograms, it became possible to compare the efficiency of the regular 1¼- by 1⅝-inch film with the bite-wing film for the purpose of finding carious areas, overhanging fillings, and excessive resorption of the alveolar process. It is concluded that the regular 1¼- by 1⅝-inch film, full-mouth series, is indispensable for locating pathology and impacted teeth hidden in the alveolar process, the mandible, and the maxillae, and that while these roentgenograms will reveal some approximal surface caries, overhanging fillings, and resorption of the alveolar process, the full-mouth bite-wing series should be made for every examination because a great many carious areas in the approximal surfaces of teeth cannot be located in any other manner.

OVERHANGING GINGIVO-APPROXIMAL FILLING MARGINS

A large number of fillings were observed which extended beyond the gingivo-approximal margins into the approximal spaces and the interapproximal crests of the gum tissue. These large masses of filling material that protruded into the approximal spaces were causing gingivitis, destruction of the gingival tissue crests, rapid resorption

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of the alveolar process, pockets between the teeth, caries in approximal surfaces of adjoining teeth, recurrence of caries, and a general insanitary condition which makes an excellent environment for a subacute Vincent's infection. A record was made of those that must be corrected if the teeth that are being affected by them are to be saved from early loss. There were 153 of these in 136 teeth of 47 officers. The elimination of these overhanging filling margins is as important as the correction of carious areas.

DENTAL TREATMENT REQUIRED

There were 420 carious areas found in 366 teeth of 77 officers; an average of 5 carious areas per officer for the total of 84 officers. The total carious areas and defective overhanging fillings that should be corrected is 573 in 84 officers; an average of over 6¾ per officer.

There were 347 teeth in 40 officers affected by an excessive resorption of the crests of the alveolar process, a condition symptomatic of the premature loss of these teeth.

Only 1 officer required no dental treatment of any description; 4 required oral prophylaxis and no other dental treatment; 79 required dental treatment other than oral prophylaxis. Seven officers urgently needed dental treatment.

ACCURACY OF EXAMINATIONS

It is almost impossible to make perfect examinations. When officers are receiving dental treatment, additional carious areas and defective fillings, which require correction, are being found soon after the annual physical examinations have been made. This indicates that the examinations, which disclosed 573 carious areas and defective fillings in the teeth of 84 officers, were not radical or made in an overzealous manner.

TABULATIONS

The following tabulations are a complete analysis of the examinations of the mouths and teeth of 84 commissioned and warrant officers with an average age of 34½ years and an average length of service of 14 years:

TABLE 1

Incidence of abnormalities

Gingival disease, cases	18
Nonvital teeth	37
Calculus, cases	69
Periapical disease, teeth	28
Abscess or fistula, teeth	3
Stomatitis, cases	0
Pyorrhoea, cases	4

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Incidence of abnormalities—Continued

Carious areas in 366 teeth	420
Teeth affected by 420 carious areas	366
Overhanging approximal gingival filling margins in 136 teeth	153
Teeth affected by 153 overhanging approximal gingival filling margins	136
Gold shell crowns with excessive gingival overhang, teeth	6
Excessive resorption of alveolar crests, teeth	347
Gingival erosion, teeth	115
General malocclusion, cases	1
Useless roots, teeth	6
Residual roots, teeth	2
Impacted foreign bodies, cases	1
Impacted supernumerary denticles	3
Impacted teeth, will not erupt normally	22
Unerupted teeth, may erupt normally	16
Missing teeth	386
Missing teeth replaced by dental prosthesis	158
Number of prosthetic dental restorations	36

TABLE 2

Number of officers affected by conditions indicated

Dental treatment urgent	7
Prosthetic dental treatment needed	4
Gingival disease	18
Nonvital teeth	28
Calculus	69
Periapical disease	19
Abscess or fistula	3
Stomatitis	0
Pyorrhoea	4
Caries	77
Overhanging approximal gingival filling margins	47
Excessive gingival overhang of gold shell crowns	5
Excessive resorption of alveolar crests	40
Gingival erosion	21
General malocclusion	1
Useless roots	3
Residual roots	2
Impacted foreign bodies	1
Impacted supernumerary denticles	3
Impacted teeth, will not erupt normally	15
Unerupted teeth, may erupt normally	7
Missing teeth, other than third molars	54
28 or more teeth present, only third molars missing	20
32 serviceable, natural teeth present	5
Require no dental treatment of any description	1
Require oral prophylaxis only and no other dental treatment	4
Require dental treatment other than oral prophylaxis	79
Require oral prophylaxis in addition to other dental treatment	69
Have prosthetic dental restorations replacing missing teeth	25

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VISIBLE TOOTH CLEANING

By Capt. H. E. Harvey, Dental Corps, United States Navy

The high incidence of dental caries reported in the survey of Commander Rehrauer in the preceding article presents a problem of considerable importance to the service. The relative significance of constitutional, dietary, and local etiological factors in the production of caries may still be a debatable question. However, it is believed that, unquestionably, the importance of oral hygiene needs emphasis for the benefit of the service. Personnel of the Medical Department are urged to manifest an active interest in indoctrinating service personnel in sound practices of oral hygiene.

Brushing the teeth is too apt to become a more or less perfunctory habit performed ineffectively because little thought has been given its purpose. The following comment is therefore presented to stimulate interest in teaching personnel to pay more attention to the use of the tooth brush, with attending beneficial results.

The objective in brushing a tooth is to remove the surrounding food residue, particularly that near the gum margin. This should be accomplished so as to present a clean surface on all sides of the tooth and without injury to the soft tissues of the gum. Instruction in use of the tooth brush will be simplified if personnel are taught to consciously endeavor to clean each tooth as an individual unit. The brush should preferably be a small, two row, medium or soft even bristle type such as illustrated in figure 7, page 381.

Personnel should be instructed to practice this technic before a mirror. Bring the mouth close enough to the mirror so that each tooth can be seen distinctly. With a little dentifrice on the tip of the brush, place it on the right central incisor allowing the handle of the brush to extent diagonally downward to the left. Make 10 full circular motions over this tooth and the surrounding gum, using gentle but firm pressure. Repeat the circular motions on the next tooth, the right lateral incisor, and then on each tooth to the rear of the mouth. While it may be difficult to see the brush on the posterior teeth once the feel of brushing the teeth individually is acquired, the end of the brush can be felt in its movements about a single tooth. When the outer surfaces of the right upper teeth are completed bring the brush back to the upper left central incisor, reversing the direction of the handle to point toward the right and go over each tooth on that side. The inner surfaces of the upper teeth should next receive individual circular brushings. Repeat the sequence on the lower teeth with the handle of the brush extending diagonally upward.

The clean appearance and wholesome feeling induced by this method will repay the efforts thus expended, and a total of 3 minutes should enable one to finish all of the teeth.

If bleeding or discomfort ensues dental treatment should be sought.

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CORONARY ACCIDENTS [1]

REMARKS ON ANTICIPATION AND PREVENTION

By Capt. George W. Calver, Medical Corps, United States Navy [2]

Of all the problems confronting modern medicine today, nothing is more interesting, nothing more intriguing to the inquiring mind, than the problem of the middle-aged man and the causative factors behind the apparently increasing number of cases of heart disease. Nothing is more startling than to see sudden death arrive in the middle-aged well-appearing, well-nourished individual, who up to that moment was considered the picture of health.

In the history of that part of medicine in which I find most of my work, I have been tremendously impressed by the frequency of coronary occlusions and wondered whether or not it was not possible, in some way, to control their incidence. In the Seventy-Second Congress there were 39 cases of coronary occlusion among the membership of the two Houses. Of this number, 33 were primary cases, 5 secondary cases, and 1 with a recurrence of 4 or 5 attacks in more or less rapid succession. Since the secondary cases all died and three of the primary died instantly, or almost immediately, the specter of sudden death became a formidable one, and as lightning strikes, we knew not where we would have to expect the next accident.

When this subject has been discussed among the group at the Medical Center, much stress has been laid on the necessity of questioning the obvious, of trying to find by study of habits and the lives of a large group of past-middle-age men just what factors enter. Why are some people "older" than others of the same age? Why do some men have no trouble, while others of similar age, appearance, and weight, die sudden deaths? Running back through these histories, there are in my mind certain similarities which might offer a clue. It is through this approach that I predicate my remarks.

In the study of these cases, I was impressed by several things: First, a frequent premonitory symptom of heaviness over the chest or shortness of breath on normal exertion; second, the not unusual history of the lack of regularity in the amount of physical endeavor; third, an almost invariably abnormal blood chemistry with an increase in blood fat or cholesterol, accompanied sometimes by an increase in blood sugar and the nitrogenous substances in the blood.

In considering the pathological physiology of the disease and the many laboratory experiments that have been done, I have in mind several very important facts. The first is, that it has long been

[1] An address delivered before the Maryland Academy of Medicine and Surgery December 20, 1938, at Baltimore, Md.

[2] Attending physician, United States Capitol. The author expresses his appreciation of the magnificent cooperation received from the officers and staff of the Naval Medical Center for the many hundreds of examinations done for him in this study.

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observed that wild animals transplanted from their normal active mode of life to the modern zoo, or other place of confinement, develop to a considerable proportion arteriosclerotic change. There have been a number of experiments done on feeding animals, where two groups have been fed on high-fat, high-cholesterol diet. The group that is allowed to run free seldom develops pathological changes in the arteries or elsewhere, as the result of their diet. The group which is confined, however, shows the cholesterol deposits in their arteries as well as other types of fatty infiltration and destruction of tissue. It is also noted that certain domestic animals which are less active in their urban surroundings also have the same tendency toward arteriosclerotic change. It must be with the recognition of the fact that the transplantation of an animal from its active, normal life to a sedentary one predisposed to a pathological change, that we proceed in our study. I doubt, therefore, that there can be any question of our premise that the human animal in his transplantation from an active, hard-working individual in the open to the sedentary, inert, physically inactive life of the urban resident is potentially liable to the same degenerative changes.

Let us remember that coronary disease is of three types: First, an acute coronary arteritis complicating infections or infectious diseases; second, a localized coronary atheromatosis and scar formation which may be extremely limited or involve only the bundle of His, resulting in complete bloc; and, third, a generalized atheromatous condition with a general decrease in the efficiency of the whole heart muscle. It is with the recollection of these types of coronary diseases that we must approach the subject and try to construct a method for its control.

The etiology of coronary occlusion, or perhaps we had better say, the background which is built up in the individual is more often the result of a combination of circumstances. We cannot say that any one particular specific condition causes coronary disease, but it would seem that we could group them under the following etiological factors:

(1) The metabolic disturbance because of improper endocrine balance.

(2) The failure to balance the energy-work-waste elimination with the food-fuel intake.

(3) The improper use of their physical machines.

(4) Low oxygen carrying power of the blood, or as better expressed, low oxidizing power of the blood.

(5) Low carbondioxide combining power and high blood-fat content.

(6) The metabolic disturbance as the result of anger, worry, fear, and other acute emotional storms.

In discussing these factors, we find that the older man, who has a tendency to coronary occlusion, is a man who is overweight 10 to 20 percent, he has occupied a job of fair responsibility and has been active in the performance of his duty. He has spent most of his time

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at his desk so that he has not used his physical machine other than as a means of transporting his mind from his house to his office and return. There are, of course, exceptions to this where a disease factor enters.

The question of blood fat is closely related with the endocrine balance but is also frequently affected by the food-fuel value consumed by the patient. In this work we have more or less arbitrarily set 180 milligrams percent as the high normal cholesterol, particularly since when we put a patient on a low-fat diet we so frequently get a reading of 150 to 170. If we have a man who is sedentary, his usual energy-work output will be far more than quadrupled by making him take a moderate walk. Numerous experiments have been done regarding the factors causing an increase in respiratory volume, so that we know that the oxygen consumption will jump from 2½ liters to 8 or more liters per minute with the individual performing a continuous physical effort as in rapid walking.

Physical exercise of necessity creates a definite method of breathing. The individual sitting at his desk, usually leaning forward, cannot expand his chest to the fullest extent and develops the habit of the semidiaphragmatic, semicostal type of breathing, making a minimum of movement of each of the two named factors. Take the same individual and make him straighten up and stand up with the head erect, shoulders back, and chin in, in other words, assuming a military position, we stimulate the dropping of the diaphram due to the weight of the abdominal organs and their contents and, also, we enable the individual to raise the rib muscles by the freeing of motion in the accessory muscles.

If we start a man walking, and teach him to walk with head erect, we immediately see him taking a deeper breath using all the factors of respiratory expansion and completely enabling the lungs to aerate, thereby increasing his vital capacity as he exercises and bringing more oxygen into the body. So does he provide the substance that permits the consumption of the food and the utilization by the structures of the body of the food-fuel values that have been eaten.

Much has been written about cholesterol. We need but think of the experiments which have been given repeatedly whereby an animal given a high-cholesterol diet and allowed to exercise showed little or no trace of atheromatosis. On the contrary, animals that are given a high-cholesterol diet and which are confined and limited in their physical effort show cholesterol infiltration in the walls of their great vessels, or other atheromatous changes. This to my mind means but one thing. That is, under a condition of sedentary living, fats, which are not consumed because of the lack of actual fuel demand, are driven by the hydrostatic and osmotic pressure of the blood into the cell structures adjacent to the blood stream and their cell content already

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containing some cholesterol has its proportion increased until the amount becomes demonstrable by the microscope and is considered pathologic.

It is my personal feeling that neither cholesterol nor blood fats of themselves hold the key to the entire situation of atheromatus change, but that the metabolic unbalance, the physical inertia, and the overloading of the human system with fuel which cannot be readily consumed form the basis on which our cases of coronary occlusion occur.

The metabolic rate should be taken and studied on the basis of known factors in physics. A hypertensive individual with a normal, or slightly below normal, basal metabolic rate is actually deficient more than it would superficially appear. When we appreciate the physical effort expended by the heart to pump against an increased peripheral resistance of hypertension, just so much should we expect an increase in the metabolic rate for that particular individual. Unless we do get the increase, the heart is not balancing the increased effort with a corresponding increase in oxygen utilization, hence there cannot be a balance in the oxidization of the food-fuel.

Fundamentally, all effort must be made toward balancing the following equation:

FOOD FUEL VALUE must equal ENERGY WORK OUTPUT

It is with these factors in mind that studies have been made with a considerable group of men past the age of 45. We are looking for a preclinical entity for which we have to find indefinite diagnostic straws rather than definite clinical signs that show the direction the wind is blowing, so to speak, and which give us a hint as to what is taking place in the metabolic furnace of the individual.

Clinically we look for changes in the blood pressure on exercise, whether or not the heart muscle is able to maintain its tone and pressure under conditions of exertion. The vital capacity is measured to standardize the individual. The patient is almost invariably overweight and has poor posture. The laboratory men look for the condition of the blood cells and the chemical constitution of the blood, paying particular attention to the tendency to increase in cholesterol and decrease in the carbondioxide combining power, giving minor attention to blood sugar and the ratio of nitrogenous compounds. In electrocardiograms we look for the height, slurring and change in type of waves, the tendency to an increase in conduction time and generally find a slowing of the rate. In an x-ray we may find a suggestion of change in the aorta and an increase in the cardiac shadow. In a kymogram we will find a loss of amplitude of the convex waves and a wave which is irregular or notched as the result of valvular closure because the tone of the myocardium is such that it is not able to withstand the shock of the pressure of the blood column in the aorta or in

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the chambers of the heart. These cannot be considered clinical entities. These are things frequently reported by the chemist or laboratory technician as within normal limits, but a slight suggestion of secondary anemia causes a corresponding loss of oxygen carrying power of the blood. It means, the vehicle for delivering the utilizing agent to the cells of the body, so that they may use food carried in the plasma of the blood, is lacking its full capacity.

It must be remembered that each individual case is a complete and separate problem to himself. That which is done for one man will not work for another, but we try to do several things: First, to create a metabolic balance in the body, limiting the food-fuel value to the energy-work output. If, in attempting to do this, we find any increase in the blood cholesterol we use thyroid in ½-grain doses once a day to increase the metabolic rate; second, we educate the individual to use himself physically, and by this physical activity, to gradually create sufficient cardiac power to provide for his method of living. This is accomplished by starting him slowly walking 10 minutes twice a day, gradually increasing the amount of walking up to an hour twice a day at a fairly good rate. We also advise him to use a cane in order to get the benefit of the increased exercise from the use of the arms. The patient is taught how to breath deeply in order that he may increase his respiratory capacity and thereby assist in oxygenating the blood. He is taught to live a life of routine—going to bed at a regular time, getting up at a regular time, eating his three meals a day at regular times, taking an afternoon nap or, at least, lying down for a half an hour and taking his exercise, preferably, the first thing before breakfast with the second period late in the afternoon. We place particular stress on the exercise before breakfast in order that by performing a certain amount of physical effort at that time we are utilizing such fuel substance as may be left over from the day before. By increasing the amount of oxygen carried in the blood these substances are consumed and a more efficient metabolic cycle is accomplished.

We try to teach a patient the hygienic benefits of a quiet mind. The person who is under nervous strain and tension, who is always keyed up, who is driving himself with the greatest amount of power with which he can force himself, is the person who is causing definite endocrine imbalance and is also tending to aggravate any tendency to coronary disease. Men must be taught to shut the desk when they leave their offices and to leave their office worries and troubles behind them. They should be encouraged to develop a hobby which will give them a complete mental diversion, whether it be stamps or woodwork, or anything else between the two extremes. The main thing to do is to clear the mind of worry and nervous tension. Wives must be taught that it is physically impossible for the human animal to be driving and working at his office all day and then to accompany

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their families on an eternal round of social functions or other engagements in the evening which interfere with their obtaining at least 8 hours, if possible in sleep, in bed a day. Mental diversion and sleep are both imperatively necessary for physical repair. Without them, it is impossible to expect the body to keep its tissues at a condition of normalcy.

Medicinal therapy is simple. By increasing the water drinking, the kidneys are flushed freely and a daily bowel movement is obtained after breakfast. Only enough sedatives are used, and this usually in the form of phenobarbital, to take the edge off of nervous tension and allay apprehension. Generally speaking, three-quarters of a grain of phenobarbital is sufficient. Specifically, we depend on the theophyllin group as a means of increasing blood supply to the heart muscle and perhaps relieving physical discomfort. We use a grain and a half of theophyllin twice a day. The first dose in the morning at 8 a. m. and the second dose between 4 and 5 in the afternoon combined with the phenobarbital. For convenience, this is given in white and red capsules with instructions to take one of each as directed. These methods are not used on all patients, but give an idea of the handling of the cases.

So far as results are concerned, remember that we had 24 occlusions in the first session of the Seventy-Second Congress when this work was started and in the past year we had but 5, with 2 deaths. We see that those men who have followed the routine and lived the life that we taught have been able to carry on and do their work. One patient who was unable to walk up and down the floor of his own apartment at the end of February of this year, 5 months later actively carried on a political campaign, speaking as many as four times in 1 day. One patient with a decided arteriosclerotic condition, marked thickening of the aorta and very noticeable changes demonstrable in the heart, both by x-ray and electrocardiogram, a patient who could not walk a half of a block without stopping for a rest, has been able to build himself up and is now, also, taking part in an active political campaign. Another patient came in my office, a jovial individual, tremendously overweight and slightly hypertensive, but with marked changes in the blood and electrocardiogram. He listened to my talk and analysis of his case and then went to a committee room, where he discussed with his colleagues the instructions that I had given him, ending up with the remark, "I don't see what the doctor thinks I am that I can follow such a routine." It so happened that several patients who had been living on this routine told him that he had better follow it up. He laughed and shrugged his shoulders, and said, "This summer, I may find time to do it but not now." He never did find time to do it, for when he got home he had to begin campaigning. He had

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a coronary occlusion and died within 6 weeks of the time he left Washington. That was an avoidable and unnecessary death.

Another case, a man of 53, had consistently refused to come into the office for a check-up, saying he was too young and felt too well. Instead of taking exercise, he had a masseur, and instead of taking care of his diet he attended many social functions. Returning one evening from a political meeting, he had an occlusion and died before medical assistance could reach him.

To sum up the management of a potential coronary case, it must consist of:

(1) Indoctrination with the philosophy of a quiet mind.

(2) The balance of the food-fuel value with the energy-work output in a metabolic furnace which is working at proper efficiency.

(3) The development and reeducation of the heart muscles to perform their normal duty with the accompanying increased vital capacity of the individual.

(4) Therapy with drugs of the theophyllin group and sufficient sedatation to relieve nervous tension and apprehension.

In this paper, I wish not to appear overly enthusiastic concerning our results. The political strain and tension under which the members of Congress have been working has in no way been lessened in the past year or so. Since mental strain and tension are of tremendous importance in this clinical picture, this must be considered. We do, however, feel that we have gone a long way toward placing the blame where it belongs on the bad habits of living which lay the foundation for coronary disease. We believe that if we eliminate the results of infection in various diseases, we can, by teaching men to live properly, decidedly reduce the incidence of coronary occlusion. We all live at too high a speed. We are all driving ourselves too fast and we should no more expect the human machine to stand up under this excessive speed than we have reason to expect an ordinary automobile tire to stand up under the excessive speed of race-track driving without being liable to a blow-out. It is going to be at least 6 or 8 years more before we can definitely say that we have reported in this paper a method of preventing the occurrence of coronary occlusion, because only time and clinical experience can tell. But, myself and my associates at the Naval Medical Center, who have been in contact with this problem, believe that the proper metabolic balance must be maintained in an individual if he is to avoid coronary disease, and unless this is done we can expect to continue seeing men fall by the wayside suffering from a condition which we, as physicians, can predict and should prevent.

We also believe that we have progressed far enough to state that a man is not likely to have a coronary occlusion, in the dangerous age (45–55), barring toxic effects, if he:

(1) Makes a daily sustained, moderate physical effort.

(2) Balances the food-fuel value with the energy-work output.

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(3) Practices the hygiene of a quiet mind.
(4) Obtains 8 hours rest in bed every night.

Remember the remarks in this address are based entirely on a long period of clinical observations. We have tried to apply our laboratory knowledge through the practical application of the clinician, and have at times been willing to disagree with the laboratory when the clinical findings have been at variance under repeated observations. These remarks are wholly based on our combined experience which really, in the last analysis, must be the criteria for the evaluation of results.

PERCEPTION TIME AND NIGHTBLINDNESS

By Lt. Comdr. John H. Korb, Medical Corps, United States Navy

Nightblindness is characterized by difficulty or inability in seeing distinctly in dim illumination. Severe nightblindness is recognized by the individual, but it may be present in mild or moderate forms without the individual being aware of its existence. The term nightblindness is now being used to designate any degree of difficulty in adapting the faculty of vision to faint illumination. Recent investigations have revealed that nightblindness is a frequent finding. Jeans and Zentmire[1] in their work with Iowa school children found between 26 and 79 percent of them deficient in dark adaptation measurements made with the Birch-Hirschfeld photometer. Jeans, Blanchard, and Zentmire[2] using a new instrument, the biophotometer[3], repeated the work on the same children and with this instrument found 16 to 69 percent were deficient. Jeghers,[4] working with students in the Boston University School of Medicine, found that 35 percent had low biophotometer readings. These investigators found that by giving vitamin A daily to these individuals, the defect in dark adaptation could be improved, and the biophotometer tests would be within normal limits.

It is the function of the retinal rods to identify objects which are dimly lighted. These rods contain a photosynthetic substance called visual purple, which, when exposed to light, undergoes a metabolic change and must be rebuilt rapidly. The visual purple system expends vitamin A and is dependent on the diet for its replacement; and the rate of regeneration of the visual purple is proportional to

[1] Jeans, P. C. and Zentmire, Z.:Prevalence of Vitamin A Deficiency Among Iowa Children, J. A. M. A. 106: 996-997, March 21, 1936.

[2] Jeans, P. C., Blanchard, E., and Zentmire, Z.: Dark Adaptation and Vitamin A; new photometric technic, J. A. M. A. 108: 451-458, February 6, 1937.

[3] Name given to the instrument by its manufacturers, Frober-Faybor Co., of Cleveland, Ohio.

[4] Jeghers, H.: Degree and prevalence of vitamin A deficiency in adults, with note on its experimental production in human beings, J. A. M. A. 109: 756-762, September 4, 1937.

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the amount of vitamin A available. Individuals whose diets were low in vitamin A gave low readings in the biophotometer test.[4]

METHOD

The instrument used for measuring the degree of nightblindness is the biophotometer. This apparatus is so constructed that it permits the measurement of the threshold of light necessary to give the visual stimilus. It has two lights, a bright one and a dim one. The bright light is constant in intensity and is used to cause metabolism of visual purple. The dim light is variable and is used to measure the rate of regeneration of visual purple.

In order that all individuals are examined under identical conditions a certain routine has been adopted[2 4 5]. This consists of placing the individual in a dark room for 10 minutes, which allows for the regeneration of the visual purple. He is then exposed to the bright light for 3 minutes, which causes visual purple to be expended. After 3 minutes of exposure his threshold of light is immediately measured with the dim light by determining the minimum amount perceptible to him at the end of 20 seconds. This reading measures the rate of regeneration of the visual purple. The intensity of the dim light is varied by a rheostat. The dial units on this rheostat range from 0 to 100, and may be transposed into millifoot candlepower by the use of a table supplied by the manufacturers of the instrument.

For the purpose of classifying individuals in this test they have been divided into three groups: Normal, border line, and subnormal.[2 5] A person is considered normal when his biophotometer dial reading is 29 to 100 (0.6 to 0.0029 millifoot candles), border line when 22 to 28 (1.0 to 0.6), and subnormal when 0 to 21 (4.87 to 1.0).

RESULTS OF THE BIOPHOTOMETER TESTS

This series of 630 individuals included 270 naval aviators, 82 naval aviation pilots, 62 chief petty officers, and 216 individuals below the rate of chief petty officer. The distribution of these readings is tabulated in table 1. As shown in table 2, it was found that in the classifications of border line and subnormal there are 5.17 percent naval aviators, no naval aviation pilots, 19.26 percent chief petty officers, and 19.45 percent individuals below the rate of chief petty officer.

[4] Palmer, C. E., and Blumberg, H: Use of dark adaptation technique (biophotometer) in measurement of vitamin A deficiency in children, Pub. Health Rep. 52: 1403–1419, October 8, 1937.

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TABLE 1

Biophotometer readings on 630 individuals

Biophotometer readings		Naval aviators	Naval aviation pilots	Chief petty officers	All other rates
Dial units	Millifoot candles				
2	4.22	------	------	------	1
15	1.60	------	------	------	1
18	1.28	1	------	------	------
20	1.10	------	------	------	2
21	1.03	------	------	1	------
22	.951	1	------	1	4
23	.881	1	------	1	3
24	.820	------	------	1	1
25	.759	5	------	2	8
26	.705	2	------	1	7
27	.657	3	------	3	6
28	.610	1	------	2	9
29	.563	2	1	------	10
30	.525	12	2	2	23
31	.487	14	3	3	15
32	.454	11	1	9	14
33	.422	15	7	8	13
34	.390	18	6	3	15
35	.364	29	9	5	19
36	.338	22	7	2	19
37	.313	16	5	3	9
38	.291	17	12	------	6
39	.270	18	5	1	3
40	.250	21	5	2	12
41	.232	17	1	3	3
42	.216	16	6	1	3
43	.200	2	4	1	2
44	.186	3	1	1	2
45	.172	3	1	3	3
46	.160	5	1	2	2
47	.149	2	1	------	1
48	.138	2	3	------	------
49	.128	------	1	------	------
50	.119	4	------	1	------
51	.110	2	------	------	------
52	.103	2	------	------	------
53	.0951	1	------	------	------
54	.0881	1	------	------	1
55	.0820	------	------	------	1
56	.0759	------	------	------	------
57	.0705	------	------	------	------
58	.0657	1	------	------	------
Total		270	82	62	216

TABLE 2

Analysis of biophotometer readings

	Naval aviators		Naval aviation pilots		Chief petty officers		Other enlisted personnel	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Normal	256	94.83	82	100	50	80.64	174	80.55
Border line	13	4.80	0	0	11	17.74	38	17.60
Subnormal	1	.37	0	0	1	1.52	4	1.85

SPEED OF PERCEPTION

In this series 45 individuals were given, in addition to the biophotometer test, a test measuring their speed of perception. Fifteen of these individuals were given 15,000 international units of vitamin A

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daily, and tested at intervals on the biophotometer and on the speed of perception instrument. Nine of these individuals were studied in detail and were given tests at least twice weekly.

METHOD

A box was constructed which included a 25-watt electric light bulb, a movable slide containing a 20/20 line of the Snellen test chart on parchment paper and a camera shutter. The procedure followed in each of these individuals was to first determine their visual acuity. If an individual could not read the 20/20 line from 20 feet he was advanced to such a place where he could easily read it. All subsequent tests on this individual were then made at this distance. Their speed of perception was first determined with the room lighted and then with the room darkened. A letter was exposed by snapping the iris shutter. If the letter was recognized the slide was moved and another letter exposed. The interval of exposure was shortened until the individual could no longer name the exposed letter and then the time of the previous exposure in which he correctly named the letter was recorded. The data obtained from all these individuals reveal the same trend. The following are reports on four cases.

Case Reports

Case 1.—J. L. H. chief photographer, age 38.

When this man was informed that, judging by biophotometer tests, he was night-blind, he volunteered the information that during the past 4 or 5 years he had noticed he was unable to focus his camera as rapidly as formerly. He believed this was due to his getting older. Examination revealed no unusual findings except that his teeth were in rather poor condition. Investigation of his diet showed a very small consumption of fruit, green vegetables, and other vitamin A rich foods. Beginning April 7, 1938, he was given 15,000 international units of vitamin A daily. On May 6, 1938, he stated that he had noted a marked improvement in his ability to focus his camera rapidly. Table 3 gives partial data obtained in this case.

Table 3

Improvement in biophotometer readings and preception time, case 1

Date	Biophotometer		Perception time, hundredths of a second	
	Dial units	Millifoot candles	Room light	Room dark
Mar. 27	22	0.951	0.25	0.50
Apr. 1	22	.951	.25	.50
Apr. 7	24	.820	.25	.50
Apr. 14	28	.610	.20	.33
Apr. 19	35	.364	.10	.20
May 6	46	.160	.04	.10

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Case 2.—P. R. C. storekeeper third class; age 24.

This man's physical examination revealed no unusual findings, and he was apparently in good health. He stated that he had never been able to find a seat in a darkened theater, and that he had difficulty in walking about in the spaces of the ship when all the lights except the blue lights were turned off. Investigation of his diet revealed that he never drank milk and never ate fruits or green vegetables. Beginning on March 28, 1938, he was given 15,000 international units of vitamin A daily. His vision in dimly lighted spaces improved rapidly. Table 4 gives partial data obtained in this case.

TABLE 4

Improvement in biophotometer reading and preception time, case 2

Date	Biophotometer		Perception time, hundredths of a second	
	Dial units	Millifoot candles	Room light	Room dark
Mar. 22	2	4.22	0.20	1.00
Mar. 26	5	3.38	.20	1.00
Apr. 1	22	.951	.20	.60
Apr. 23	30	.525	.10	.25
May 5	38	.291	.04	.20
May 19	46	.160	.02	.10

Case 3.—A. C. M.; aviation cadet; age 27.

Examination of this cadet revealed no unusual findings. He was in good physical condition and did not believe that his vision in dimly lighted spaces was less acute than the rest of his shipmates. Investigation of his diet showed that he ate fruits and vegetables in very small quantities and that he did not drink milk. Beginning March 26, 1938, he was given 15,000 international units of vitamin A daily. Two months later he stated that before he began taking vitamin A he had noted that when flying in formation at night, if he looked at the running lights on the airplane ahead and then at the body of the airplane, its outline would not be visible for a moment. This momentary blindness had disappeared May 1938. Table 5 gives partial data obtained in this case.

TABLE 5

Improvement in biophotometer reading and preception time, case 3

Date	Biophotometer		Perception time, hundredths of a second	
	Dial units	Millifoot candles	Room light	Room dark
Mar. 22	18	1.26	0.10	0.80
Mar. 26	22	.951	.10	.80
Apr. 1	26	.705	.10	.80
Apr. 7	35	.364	.04	.25
Apr. 23	38	.291	.04	.10
Apr. 30	42	.216	.02	.04

Case 4.—D. J. W.; naval aviator; age 36.

This officer was in good physical condition. Investigation of his diet revealed consumption of liberal quantities of milk, fruits, and vegetables. He was in-

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formed that his biophotometer reading was average and that he was not nightblind. Over a period of 15 days he returned several times trying to improve his reading and when it was found to remain practically constant he requested that he be given vitamin A so that he would be above average. Beginning March 26, 1938, he was given 15,000 international units of vitamin A daily. In June 1938 he stated that the headlights on approaching automobiles did not blind him as much as formerly. Table 6 gives partial data obtained in this case.

TABLE 6

Improvement in biophotometer reading and preception time, case 4

Date	Biophotometer		Perception time, hundredths of a second	
	Dial units	Millifoot candles	Room light	Room dark
1938				
Mar. 10	35	0.364	0.04	0.10
Mar. 26	34	.390	.04	.10
Apr. 7	42	.216	.02	.04
Apr. 30	48	.138	.02	.02

DISCUSSION

Nightblindness exists in the personnel of the Navy. The number of personnel involved is difficult to determine as it is not believed that a satisfactory criterion has yet been established to distinguish those who have an adequate vision in dim illumination from those who are inadequate. It is believed that the minimum dark adaptation unit acceptable will be one which will have a perception interval not considered to be hazardous. The individuals tested in this series had perception intervals ranging from 1 second to one-fiftieth of a second. This means that for some individuals a letter must be exposed for one second to produce sufficient change in the visual purple system to make it recognizable, while for others an exposure of one-fiftieth of a second is sufficient for them to correctly call the test letter. Nightblind individuals not only need a greater intensity of light to see objects, but they also need a longer interval of exposure of an image on the retina for its identification.

Each individual to whom vitamin A was given had an improvement in his biophotometer test and also had a decrease in the time of his perception interval. These individuals were instructed how to balance their diets and in addition were given 15,000 international units of vitamin A daily. The body is dependent on the diet for its supply of vitamin A. Some individuals refrain from including milk, fruits, and vegetables in their diets. In this series there was no relation between the incidence of nightblindness and age groups.

Palmer and Blumberg[5] working with children found that the results of repeated tests on the same individual tended to show im-

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provement in the biophotometer readings even though no vitamin A was administered. The individual variability, and the practice or learning factor in this subjective test made it unreliable for testing mild degrees of vitamin A deficiency in school children. This was not found to be true in this series. As stated before, 45 individuals were given repeated tests and 15 of these were given vitamin A. Those who were not given vitamin A did not improve in either the biophotometer readings or in the perception interval.

A delay in the detection of an object is hazardous. This will become apparent when the time of the perception interval is expressed in feet traveled by a vehicle advancing at the rate of 60 miles per hour. At this speed during each second there is an advance of 88 feet and during each one-fiftieth of a second there is an advance of 1.76 feet. Table 7 has been prepared to show the number of feet traveled at the rate of 60 miles per hour, during their perception interval, before and after the treatment with 15,000 international units of vitamin A, on these four cases.

TABLE 7

Relation of perception interval to speed of travel

	Case 1		Case 2		Case 3		Case 4	
	Before	After	Before	After	Before	After	Before	After
Dial units	22	46	2	46	18	42	35	48
Perception interval	0.50	0.10	1.0	0.10	0.50	0.04	0.10	0.02
Feet traveled	44	8.8	88	8.8	44	3.52	8.8	1.76

COMMENT

The selection of a standard which will be considered the dividing line between adequate and inadequate dark adaption will have to be determined by further investigation. As stated before, a person is now considered normal if his biophotometer reading is 28 dial units or above. In this series those whose biophotometer dial unit reading was 25 to 30 had a perception interval of one-half to one-fourth second. It is believed that the perception interval should not be less than one-tenth of a second. Practically all of the individuals who had a perception interval of one-tenth of a second had a biophotometer reading from 34 to 38 dial units. It is believed that this gives adequate vision of dimly lighted objects and a perception interval short enough to meet emergencies. In the meantime we should instruct our personnel as to the foods that they should include in their diet and assure ourselves that those who purchase the food and plan the menus include these foods in the meals served.

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SUMMARY

1. A series of 630 individuals on whom the light and dark adaption was performed is herewith reported.

2. Those classified below normal included 5.17 percent of naval aviators, no naval aviation pilots, 19.26 percent chief petty officers and 19.45 percent below the rate of chief petty officer.

3. There was no relation between the incidence of nightblindness and age groups.

4. Definite evidence of a relationship between the incidence of nightblindness and the diet was found.

5. An investigation was made on 45 individuals to determine the relation between nightblindness and perception time.

6. 15,000 international units of vitamin A given daily improved markedly the biophotometer readings and shortened markedly the perception interval.

7. No improvement was noted in those not given vitamin A.

ACKNOWLEDGMENTS

Appreciation is hereby expressed to Lt. (Jr. Gr.) J. C. Flemming, Medical Corps, United States Navy, for his permission to use the biophotometer readings of 139 naval aviators and 82 naval aviation pilots, in this investigation, and to Michael J. Walsh, M. Sc., F. I. C., A. I. Ch. E., instructor in applied nutrition, extension division, University of California, for his professional advice in numerous consultations.

REVISION OF THE HAGUE CONVENTION

By Capt. Lucius W. Johnson, Medical Corps, United States Navy

INTRODUCTION

One of the many persons set astir by the admirable work of Florence Nightingale in the hospitals of the Crimean War (1853–56) was M. Henri Dunant, a citizen of Switzerland. During the Italian campaign of 1859 he organized a band of mercy to care for those wounded in the battle of Solferino. After that experience he returned to his home and wrote a brochure entitled "Un Souvenir de Solferino," which described the scenes of suffering that he had witnessed. Then he submitted the question, "Would it not be possible to found and organize, in all civilized countries, permanent societies of volunteers which in time of war would render succour to the wounded without distinction of nationality?"

The idea spread rapidly throughout Europe. Dunant traveled from country to country, obtaining the indorsement of crowned heads

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and governments for his project. He successfully advocated two schemes, one of which has been perpetuated in the Red Cross societies; the other led to the international treaties for amelioration of the condition of the sick and wounded in war.

The first international conference at Geneva was inaugurated on October 26, 1863, and the second on August 8, 1864. At its close, on August 22, the articles which make up the Geneva Convention of 1864 were signed. The later Geneva Convention of 1868 provided the additional articles relating to marine warfare. Other Geneva conventions for modification of the treaties relating to land warfare were held in 1906 and 1929.

In 1899 a peace conference was held at the Hague, and had for its purpose the adaptation to maritime warfare of the principles of the Geneva convention. This was proclaimed by the President of the United States in November 1901. Another convention was held at the Hague in 1907, to adapt the principles of the Geneva convention of 1906 to war at sea. This is the one usually spoken of as "The Hague Convention."

In the preparation of these treaties, the best available minds of the legal, maritime, and diplomatic professions were assembled, and they made every effort to express the purpose of the various articles in clear and unequivocal language, which should be capable of only a single interpretation. But time moves on; new ideas and inventions create new situations and viewpoints. Minds equal in cleverness to those of the treaty makers were concentrated on the task of finding loopholes in the agreements, or bending them to the temporary advantage of one nation or another. There is strong temptation to gain military superiority by shrewd devices under the protection of the treaties, and no great leader is too high-minded to indulge in wishful thinking on the profits of successful evasion. In war the pressure for success at any price is so great that strict adherence to the rules imposes a great strain on the character of the leader. So, let us not judge them too severely if they yield a little, especially since some of the early violations lie on our own doorstep.

When ships return from a long and stormy cruise, it is customary to send them to the yard for overhaul, to discover and repair whatever damage may have been done by the unusual strains to which they have been subjected. We should follow a similar course with treaties, have them examined and revised after every major war, for during that period they will have undergone unusual strains, a considerable degree of corrosion, and more than a little sabotage.

For a quarter of a century it has been widely recognized that the present chaotic state of the international treaties relating to the amelioration of the condition of the sick and wounded in warfare should be corrected. Such action was taken with regard to land war-

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fare by revision of the Geneva convention in 1929. On June 15, 1937, a committee met in Paris, under the aegis of the International Red Cross, for revision of the Hague convention, and to consider whether there could not be a single convention applying to all three forms of warfare, land, sea, and air. Rear Adm. C. M. Oman and Capt. W. L. Mann, Medical Corps, United States Navy, were members of this committee. No decision was reached on the latter subject, but the report on the former is now available for study. Let us examine it paragraph by paragraph.

CHAPTER 1—CONCERNING THE SICK, WOUNDED, AND SHIPWRECKED

ART. 1. Soldiers and sailors embarked on board ship, and other persons officially attached to the land, sea, or air, armed forces, shall be respected and protected in all circumstances when wounded or sick; they shall be treated humanely and cared for, without distinction of nationality, by the belligerent in whose power they may be.

The benefits of the foregoing provisions shall also be extended to the sick, wounded, and shipwrecked, from any vessel which is the victim of an act or incident of war.

This article combines the provisions of article 11 of the Hague convention with article 1 of the Geneva convention. It is expanded to include personnel of the air force as well as the land and sea armed forces. For the first time, shipwrecked persons receive the same consideration as sick and wounded. This is important, since many of the shipwrecked will be able-bodied combatants, perhaps fully armed.

Paragraph 2 is new, and widens the field to include those rescued from merchant or war ships sunk by mines or any other mishap brought about by hostilities. There is no distinction among civilians, merchantmen, and combatants, a very wide recognition, which civilians do not enjoy under the present treaty.

ART. 2. The wounded, sick, or shipwrecked of one belligerent who fall into the power of the other, shall be prisoners of war. It lies with the captor to decide, in accordance with circumstances, whether to hold them or to send them to a port of his own country, to a neutral port, or even to an enemy port. In this last case, prisoners thus returned to their own country shall not again serve throughout the duration of the war.

This is a reproduction of article 14 of the Hague convention. The point is emphasized, and it is repeated again and again in this report, that persons who have once been in the power of the enemy and released under treaty provisions, cannot again take part in warlike activities.

ART. 3. Any war vessel belonging to a belligerent may demand the surrender of the wounded, sick, or shipwrecked men on board naval hospital ships, hospital ships belonging to relief societies or to private individuals, merchant ships, yachts, and other boats, whatever the nationality of such vessels may be.

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This is a repetition of article 12 of the Hague convention. It represents an effort to reach an agreement on the proper procedure in cases such as that of the *Deerhound*, which has caused, for 70 years, a great deal of acrimonious dispute. During the battle between the U. S. S. *Kearsage* and the Confederate cruiser *Alabama*, off Cherbourg, in June, 1864, Captain Semmes and several men of the *Alabama* were rescued by the British yacht *Deerhound*. Demand for their surrender was made, but the captain of the yacht claimed the inviolability of a neutral flag, and refused to accede to the demand. Not only were the men landed on neutral soil, but Captain Semmes and some of the men took part in later hostilities.

This article also reflects an occurrence of the Spanish war, when an amusing bit of chicanery was frustrated. In the afternoon of July 26, 1898, Commander Albert S. Snow, of the U. S. S. *Badger*, was blockading the Cuban port of Neuvitas. He saw a large seagoing tug, towing a barge and a brigantine, coming out of the harbor and heading toward Havana. Each craft was flying Spanish colors, a Red Cross flag, and a quarantine flag. He brought them to with a shot across the bow, and sent a boarding party, which was warned to keep off because of the presence of yellow fever on board. The vessels were found to be carrying nearly 300 soldiers, most of them in perfect health, with no evidence of any yellow fever. All were made prisoners. Article 3 indicates the proper solution for cases such as those given above.

ART. 4. Should wounded, sick, or shipwrecked persons be embarked on a neutral warship, steps must be taken to prevent their further participation in operations of war.

This repeats article 13 of the Hague convention, but makes it more binding by omitting the weasel words, "so far as possible," which weaken the present provision. This duty to intern the sick, wounded, and shipwrecked men of either side when once taken on board a warship of a neutral country is a strict obligation, and neglect of it would rightly be regarded as an unfriendly act. A case in point occurred at the outbreak of the Russo-Japanese war, in February 1904, when British, French, and Italian war vessels at Chemulpo rescued men from the sinking Russian ships *Korietz* and *Variag*, and refused to surrender them to the Japanese. Such cases are now clearly covered by articles 12 and 13 of the Hague convention, and articles 3 and 4 of the proposed revision.

ART. 5. The wounded, sick, or shipwrecked persons landed by belligerent war vessels at a neutral port with the consent of the local authorities, shall be detained by the neutral State concerned, so as to prevent their taking further part in operations of war, failing any contrary arrangement between the neutral and the belligerent States.

The costs of their maintenance and internment shall be borne by the State to which such shipwrecked, wounded, or sick persons belong.

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Should these wounded, sick, or shipwrecked men be landed in a neutral port by private and neutral merchant ships, boats, yachts, or aircraft which have assumed no obligation whatever toward one of the belligerent powers, such wounded, sick, or shipwrecked men shall be free.

War vessels arriving in a neutral port shall be free, subject to the consent of the neutral State, to land any wounded, sick, or shipwrecked they may have on board.

Paragraph 1 would make clear the status of patients landed by war vessels of belligerents, while paragraph 3 applies to those landed by private and neutral vessels and who have never been in the power of the enemy. The latter is the only class of persons belonging to belligerent nations who, when landed in neutral ports, need not be interned. But if the private or neutral vessel should be stopped or boarded by a belligerent ship while the rescued persons were on board, the neutral country would be obligated to intern them for the duration of the war. While it is not definitely stated in the article, the report of the commission states that the term "belligerent war vessels" includes all ships flying the flag of a belligerent, with the exception of hospital ships, which are immune to capture. It is taken to mean all vessels subject to capture, with no distinction between battleships, merchantmen, or yachts.

It will be noted that the report of the commission makes no mention of the status of men landed in a neutral port from hospital ships of any of the three categories. There was a division in the commission on this point, representatives of certain countries feeling that such persons should be free, while others believed they should be interned. Should the report be adopted in its present form, the status of such persons would be a matter for diplomatic adjustment between the belligerents and the neutral country involved. The outcome would conceivably be predicated upon the strength of the neutral, its geographical location, and its sentimental or commercial leanings toward one or the other belligerent. It would seem better to make a decision on this point, rather than to leave it to be decided during war, on a basis of opportunism.

Paragraph 4 is new, and is intended to provide, for war vessels having sick and wounded on board, a convenient means to rid themselves of such incumbrance, while insuring their internment. It is the humanitarian purpose of this paragraph to secure the better treatment that would presumably be available in hospitals on shore.

ART. 6. After every engagement the two belligerents shall, insofar as military considerations allow, take steps to search for the shipwrecked, wounded, and sick, and to protect them, together with the dead, from pillage and maltreatment.

This article reproduces article 16, paragraph 1, of the Hague convention.

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ART. 7. The belligerents shall advise each other, as soon as possible, of the names of the wounded, sick, and dead collected or discovered, together with any indications which may assist in their identification.

They shall establish and transmit to each other the certificates of death.

They shall likewise collect and send to each other all articles of a personal nature found in captured vessels or on the dead, especially the one-half of their identity disks, the other half to remain attached to the body.

They shall insure that burial on land or at sea, or cremation, is preceded by a careful and if possible medical examination of the bodies, with a view to confirming death and establishing identity for purposes of record.

Whenever wounded, sick, or dead are collected by neutrals the latter shall assume as toward the belligerents the obligations laid down in the foregoing paragraphs.

This article is similar to article 17 of the Hague convention, but elaborated to bring it into line with article 4 of the Geneva convention of 1929, with the purpose of providing uniform treatment for men of the land and the sea forces. In considering cases brought ashore, the sick, wounded, shipwrecked, and dead, so long as they remain on board ship are subject to the Hague convention, but when they are brought ashore they come under the Geneva convention. This is true whether they be soldiers, sailors, relief personnel, or merchantmen.

ART. 8. Belligerents may appeal to the humanity of the captains of neutral merchant ships, yachts, or boats, to take on board and care for wounded, sick, or shipwrecked men.

Vessels responding to such an appeal, and those having of their own accord rescued wounded men, shall enjoy special protection and certain facilities.

They shall in no case be captured for having undertaken such transports; nevertheless, failing assurances to the contrary, they remain subject to capture for any violations of neutrality they may have committed.

This article is the same as article 9 of the Hague convention, except that the word "facilities," in the second paragraph, is substituted for the word "immunities." The failure to define more accurately the facilities to be enjoyed would appear to reduce its effect almost to the vanishing point. The report of the commission comments on the fact that war vessels might find it expedient to place their sick, wounded, and shipwrecked men on a neutral vessel and then divert that vessel from its course, to prevent it from giving information of the presence of the war vessel in the vicinity. In case the neutral vessel belonged to a weak power, or one suspected of sympathetic leaning toward the enemy, the commander of a war vessel might find, in the third paragraph of this article, convenient justification for detaining or diverting the merchantman. The direct statements in this article are so weakened by what might be called hedge phrases, that it appears to be of only suggestive value.

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Chapter 2.—Concerning Hospital Ships

The corresponding chapter of the Hague convention has the words, "and Floating Hospitals." It was thought better to omit references to hospital transports, lest there be some implication of different status for the two types of vessels. It was recognized that the essential purpose of hospital ships is not transport, but to remove patients from warships and provide proper care for them. In planning the equipment and employment of these ships we differentiate between the hospital ship and the hospital transport, the latter being fitted and used to evacuate patients from an advanced base or the scene of a war, to hospitals at home or at a distant haven. The revision very properly would make no distinction between the rights of the two.

Art. 9. Naval hospital ships, that is to say, ships built or fitted out by Governments specially and solely for the purpose of succouring the wounded, sick, and shipwrecked, the names of which have been communicated to the belligerent Powers on the outbreak of or during hostilities, and in any case before they are brought into use, shall be respected and immune from capture.

Art. 10. Hospital ships operated by individuals or officially recognized relief societies shall likewise be respected and exempt from capture, provided that the belligerent Power to which they are subject has given them an official commission and has notified their names to the enemy Power, on the outbreak of or during hostilities, and in any case before they are brought into use.

Such ships must carry a document from the competent authority certifying that they have been under its supervision both while equipping and on final departure.

Art. 11. Hospital ships operated by individuals or officially recognized relief societies in neutral countries shall be respected and exempt from capture, provided that they are placed under the orders of one of the belligerents with the previous consent of their own Government and with the authorization of the belligerent himself, and that the latter notifies their names to the enemy at the outbreak of or during hostilities, and in any case before use is made of them.

Articles 9, 10, and 11 are only slightly changed from the first three articles of the Hague convention. They state unequivocally that hospital ships are immune from capture. It has been proposed that the three articles be combined into one, since the three types of hospital ships are subject to the same rules, immunities and perils, but it was decided to retain the different classes. While, to us, there may appear to be no reason for the various classes of hospital ships, certain European powers hold very tenaciously to the opinion that such distinctions are necessary to clarify the status of hospital ships provided by their allies or by relief societies.

Art. 12. The ships mentioned in articles 9, 10, and 11 shall afford aid and assistance to the wounded, sick, and shipwrecked of the belligerents without distinction of nationality.

The Governments undertake not to use such ships for any warlike purpose.

Such ships shall in no wise hamper the movements of the combatants.

During and after an engagement they shall act at their own risk and peril.

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The belligerents shall be entitled to supervise and search such vessels. They may refuse their assistance, order them to withdraw, give them sailing orders and temporarily place a commissioner on board, or even provisionally detain them, should the gravity of the circumstances warrant this course.

As far as possible, belligerents shall enter in the log books of hospital ships any orders they may give them.

The right of a belligerent to order a hospital ship to withdraw was employed by the German Government in the World War as justification for their edict that they would no longer suffer any enemy hospital ships within certain areas, which included the English Channel. If any were encountered in the forbidden zone, they would be attacked without further consideration. Other nations refused to accede to this interpretation, holding that such ships could be ordered to withdraw only after visit to the individual ship. It would seem highly desirable that this provision, once having been the subject of controversy, should be completely clarified when revision is undertaken.

In the fifth paragraph the words "temporarily" and "provisionally" have been added, for what purpose it is hard to see, unless to weaken the effect of the paragraph. It has been stated that it was done to make clear that the right of supervision and search is of a strictly temporary character. Since these words will undoubtedly be construed by a captor as including the time necessary for a prize court to examine the evidence and decide the validity of capture, the inclusion of these words appears to add nothing to the immunity of hospital ships.

The matter of putting a neutral observer or control officer on board has been widely discussed, and appears to have considerable merit. In 1917, Germany and France reached an agreement whereby Spanish officers were taken on board certain hospital ships as observers, so as to be able to testify that no improper use was made of such ships. This worked well, and there were no more French hospital ships sunk in the Mediterranean area. The amount of authority that a control officer could or should have is debatable. Should he be able to give orders to the captain of the ship, or should his function be purely advisory? Would his presence on board deprive the enemy of the right of visit and search? Suppose a hospital ship with a neutral observer were stopped by an enemy warship and a commissioner put on board; what would be the relation of the observer to the commissioner? This matter opens up many interesting possibilities, which should be provided for in any bilateral agreements between belligerents. The report of the commission does not attempt to decide such questions, but it suggests to the governments the possibility of setting up some supervising agency, perhaps by the additional agreements provided for in article 29.

ART. 13. The vessels mentioned in articles 9, 10, and 11 shall not be assimilated to war vessels as regards their stay in neutral ports.

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Article 1, paragraph 2, of the Hague convention provides these special privileges only for hospital ships belonging to the belligerent governments, but this change would give equal rights to all three classes. This exemption of hospital ships from port dues and taxes in time of war first appears in the convention signed at The Hague in December 1904. In addition to this, the time of stay in a neutral port without being interned is not limited to 24 hours, as is that of combatant vessels.

ART. 14. Merchant vessels which have been transformed into hospital ships shall not be put to any other use throughout the duration of the hostilities.

This article is entirely new, and it undoubtedly arose out of a matter which was found to be annoying by the Germans during the World War. Their memorandum of January 28, 1917, states: "Furthermore, the British Government did not, as is the general custom, equip certain ships once and for all as hospital ships for use for the duration of the war, but often placed one and the same ship on the list of hospital ships, and then again canceled it from the list, so that the German Government was hardly able to convey to its naval forces in due time information to the required effect. The steamship *Copenhagen*, for instance, which was used by the British Government as a transport, was notified as a hospital ship in a note from the American Embassy at Berlin, dated October 14, 1914; subsequently, on February 6, 1915; she was notified as having been struck off the list, on January 1, 1916, again added to the list; and on March 4, 1916, again struck off the list. This procedure conveyed the impression that uncertainty and confusion were to be aroused regarding the character of the ships used for this purpose, which permitted the display of the peaceful or belligerent character of the ship according to the requirements." Adoption of this article would prevent retransformation of such ships.

The German memorandum also stated, "After the victorious completion of the Gallipoli campaign, the Turkish Government informed neutral powers, in a note of protest, that the English commanders had used the hospital ships in the eastern part of the Mediterranean for the purpose of bringing back troops and military supplies." This new article would prohibit such use of a vessel which had once been notified as a hospital ship.

ART. 15. The protection to which hospital ships and the sick bays of vessels are entitled shall cease if they are used for the purpose of committing acts harmful to the enemy.

It shall, in particular, be forbidden for hospital ships to use any secret code for communications, either by signals or by wireless telegraphy.

The following circumstances shall not be held to justify the withdrawal of protection:

(1) The fact that the personnel of such vessels is armed for the maintenance of order and the defense of the wounded and sick.

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(2) The existence on board of wireless-telegraphy apparatus, small signal guns or line-carrying guns.

(3) The fact of finding on board hospital ships or in sick bays small arms and ammunition taken from the wounded, sick, or shipwrecked and not yet handed over to the proper authority.

This article contains a number of new provisions, made necessary by occurrences during the World War. Paragraph 2 covers the case of the German hospital ship *Ophelia*. She was captured and in May 1915 condemned by a British prize court on the following grounds: (1) She had never rendered any help, succor, or service whatsoever to any wounded, sick, or shipwrecked men; (2) that she made no real effort at any time to render any such service; (3) that her construction and equipment were not adapted for the purpose of a hospital ship; (4) that she was well equipped for acting as a signaling ship; (5) that her officers complied with orders from German ships of war. She had on board 1,200 signaling lights. When about to be boarded, a number of books and documents were thrown overboard and others were burnt. She increased speed to avoid being searched by a British warship. All of these were regarded as evidences of guilt, and this new paragraph makes it clear that such practices are illegal. The later paragraphs specify exactly what guns, small arms, and ammunition may be permitted on a hospital ship.

It would seem a remote contingency, that a hospital ship should be used to harm the enemy, but at least two such occurrences in the past can be charged against our own account. In the Spanish-American War both sides agreed to observe the Geneva convention, but each was guilty of abuse of its provisions. The United States hosp ship *Solace*, on two occasions, interfered with the progress of Spanish vessels, detaining them so that the slower warships could overtake and capture them. The captain of the hospital ship even put in a claim for prize money for the part the *Solace* played in the capture of the *Adula*. These acts were violations of articles 13 and 14 of the treaty.

Another case of committing acts harmful to the enemy came after the Battle of Tsushima, on May 27, 1905, when the Russian hospital ship *Oryol* was taken into Sasebo by the Japanese men-of-war *Sadu-Maru* and *Manju-Maru*. The *Oryol* was condemned as a prize on several counts: (1) That she had been used to carry orders of the commander in chief of the Russian Pacific Squadron to other vessels during the 7-month cruise from Libau to Tsushima; (2) that she was carrying the master and three members of the crew of the British ship *Oldhamia*, which had been captured by the *Oleg*, and they were not sick, wounded, or shipwrecked; (3) she had been sent to purchase, in Capetown, 11,000 feet of insulated wire for the use of the combatant ships; (4) when the Russian Squadron was approaching the Tsushima

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Channel, the two hospital ships, *Oryol* and *Kostroma*, were placed at the head, in the position usually occupied by scouting ships. These cases illustrate some of the things that hospital ships should not do.

ART. 16. The religious, medical, and hospital personnel of hospital ships shall be respected and protected in all circumstances; in no case shall they be taken prisoners.

The same rule shall apply to the crews of hospital ships and to those of any aircraft attached to them, during the time they are thus employed.

This new paragraph puts into words what has always been the spirit of the Hague convention, that the protection and immunity from capture enjoyed by hospital ships extends also to their personnel, who form an integral part of the vessel, so long as they are actually engaged in manning the ships or are responsible for them. There is no mention, either in the treaty or the suggested revision, of the character of the personnel who man the hospital ship. It has been held in the past, that a hospital ship officered and manned by combatant personnel, as is the U. S. S. *Relief*, would have no protection under the treaty, and nations have scrupulously avoided having their hospital ships in time of war manned by combatants. But the second paragraph would seem to establish clearly the fact that it would make no difference who constituted the crew of the ship; they are protected in any case, as is the ship.

This article also anticipates and provides for the use of aircraft as adjuncts to hospital ships, a use which is likely to be greatly expanded during maritime warfare of the future.

ART. 17. The religious, medical, and hospital personnel of all captured vessels shall be respected and protected in all circumstances.

Should they fall into the hands of the enemy, they shall not be treated as prisoners of war.

Naval ratings specially trained for employment, when necessary, as auxiliary orderlies or stretcher bearers for the removal, transport, and treatment of the wounded and sick, and duly provided with a document of identity, shall enjoy the same treatment as regular naval personnel, if they are captured while carrying out these duties.

This new article gives to hospital attendants and stretcher bearers on board ship the same protection which the Geneva convention confers on similar persons serving with land forces. It is always a question how important such immunity is to naval personnel. In the World War, combatant ships with many wounded on board usually sank, thus reducing the problem of surgical care. Hospital personnel are frequently resentful of the immunity which distinguishes them from their associates and are likely to expose themselves to danger unnecessarily as an act of compensation. This has been mentioned as one of the reasons for the very high ratio of casualties among hospital corpsmen with our forces overseas.

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ART. 18. The persons designated in article 17 may not be held after falling into the hands of the enemy. In the absence of any agreement to the contrary, they shall be landed as soon as possible, insofar as considerations permit.

Pending their return they shall continue to carry out their duties under the direction of the enemy; they shall preferably be detailed to care for the wounded and sick of the belligerent to whom they belong.

On their departure, they shall take with them the effects, instruments, and arms belonging to them.

This article modifies article 10, paragraph 2, of the Hague convention to harmonize it with the Geneva Convention of 1929.

ART. 19. Belligerents shall see that the personnel mentioned in article 17, while in their hands, receive the same rations, the same quarters, insofar as accommodations on board permits, the same allowances, and the same pay as the corresponding personnel of their own navy. On the outbreak of hostilities they shall agree as to the corresponding ranks in their respective medical services.

This article modifies article 10 of the Hague convention to bring it into line with article 13 of the Geneva convention of 1929.

ART. 20. In the event of fighting on board war vessels, the sick bays shall be respected and spared as far as possible. Such sick bays and their material shall remain subjects to the laws of war, but may not be diverted from their purpose so long as they are required for the wounded and the sick. Nevertheless, commanders into whose power they may fall shall have the right, in case of urgent military need, to make use of them, provided always that they first make provision for the welfare of the wounded and sick who are being treated therein.

This article shows little change from article 7 of the Hague convention. It provides for a contingency which would be quite rare in modern naval warfare. Sick bays, being in the soft part of the ship, are abandoned when battle impends, and dressing stations behind armor are manned. It is problematical whether such dressing stations would enjoy the protection which is conferred on sick bays in the event of a fight on board ship. Certainly, one should not expect too much consideration in the heat of battle.

It will be noted that the protection does not extend to the sick bays of ships other than war vessels. But, since the term "war vessels" is interpreted as including all ships which are subject to capture, the protection is quite general.

ART. 21. The provisions of article 18 of the Convention of Geneva of July 27, 1929, shall apply in the case of hostilities at sea.

To those provisions shall be added the following: Medical hydroplanes shall obey every summons to alight. In the event of such compulsory descent, or of involuntary descent, the wounded and sick, together with the medical personnel and material, including the aircraft, shall remain entitled to the protection provided for by the present convention.

This article is entirely new, and would recognize the widespread use of aircraft for evacuation of sick and wounded which will undoubtedly occur. The article 18 of the Geneva convention extends the protection of the treaty to aircraft used exclusively for the removal

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of sick and wounded; prescribes their distinctive painting, and prohibits flights over territory occupied by the enemy.

Military operations in Abyssinia, Jerusalem, Spain, and China have witnessed great advance in transportation of patients by air, and it is certain to grow in favor. A question is submitted for discussion. Would it be desirable to employ medical officers who are also qualified pilots to conduct planes used for medical transport and would it be advisable to train additional medical officers as pilots with this in mind? It would reduce the crew by one member, and insure continued care of the patients if captured or grounded.

ART. 22. The Red Cross emblem shall figure on the flags, armlets, and all material belonging to the Medical Service, with the permission of the competent naval authority.

This matter is taken from article 20 of the Geneva convention of 1929.

ART. 23. The medical, religious, and hospital personnel protected under article 16, paragraph 1, and article 17, paragraph 1, shall wear, affixed to the left arm, an armlet bearing the distinctive emblem, issued and stamped by a naval authority.

The medical, religious, and hospital personnel of naval hospital ships and the personnel mentioned in article 17, paragraph 3, shall be provided with a certificate of identity, in the shape either of an entry in their service pay book or of a special document.

The medical, religious, and hospital personnel of the ships mentioned in articles 10 and 11 who have no service uniform, shall be provided by the competent naval authority with a certificate of identity, with photograph attesting their status as medical personnel.

The certificates of identity shall be uniform and of the same pattern in each navy.

In no case shall the medical personnel be deprived of the badges or certificates of identity belonging to them.

In case of loss, they shall be entitled to obtain duplicates.

This new paragraph embodies the provisions of article 21 of the Geneva convention of 1929, and provides means for identification of persons attached to hospital ships operated by private individuals or by officially recognized relief societies. Articles 22 and 23 are designed to limit the abuses of the Red Cross emblem which have been frequent in recent wars.

ART. 24. The ships mentioned in articles 9, 10, and 11 shall, to distinguish them, be painted white, with a horizontal red band approximately 1 meter and a half in width.

The boats of such ships, together with any small craft used for hospital work, shall be similarly painted.

The deck and the funnels and other superstructures of the ships mentioned in paragraph 1 of the present article shall be painted white and shall display large red crosses, so that their distinctive emblems may be clearly visible to the land, air, and naval forces of the enemy.

All hospital ships shall make themselves known by hoisting, with their national flag, a white flag with the red cross and, also, if they possess the nationality of a neutral State, by flying at the mainmast the national flag of the belligerent under whose direction they are placed.

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Hospital ships provisionally detained by the enemy under article 12, shall haul down the national flag of the belligerent to whom they are attached.

Should the ships and boats above mentioned desire to ensure by night the respect to which they are entitled they shall, subject to the consent of the belligerent they are accompanying, take the necessary steps to render the painting and the distinctive emblems by which they are characterized sufficiently apparent.

This article would require all three types of hospital ships to be painted the same, instead of some with green stripes and some with red, as required by the Hague convention. The different color was provided because the additional articles of 1868 made naval hospital ships subject to capture, while private and neutral hospital ships were not. Also, the sick and wounded on naval hospital ships could be made prisoners, while those on ships of the other two classes could not. Under the Hague convention all enjoy the same immunity, and there seems to be no reason for different painting.

Additional markings for hospital ships, to facilitate identification by aircraft, are provided. Red crosses and national flags arranged to be seen from above have frequently failed to protect from bombing and machine gunning in recent years. In Abyssinia and China they have appeared to attract special attention from airplanes, which have showered down most bountifully upon them. Such markings must be very large, to be seen from bombing altitudes. As a personal experience, I was unable to distinguish a large red-cross flag spread on the awning of the *Relief*, while flying at a height of 1,000 feet above it.

The difficulties of illuminating the special markings are well known, and the failure of the report to specify any particular method is a confession of futility. During the World War the *Mercy* and *Comfort* were required to remove the lights which illuminated their special markings because they were considered a menace to navigation while anchored in harbor, and the special devices could not be distinguished at a distance of a quarter of a mile.

ART. 25. The provisions of the present convention shall be respected by the high contracting parties in all circumstances.

If, in time of war, any belligerent should not be a party to the convention, its provisions shall nevertheless be binding as between all the belligerents who are parties thereto.

This article would effect a very important change. The Hague convention applies only if all the belligerents are parties to it, or declare their adherence when war comes. The revision would make the treaty binding on all belligerents who were parties to it even though some of the nations involved were not obligated by it. A similar change was adopted in the Geneva convention of 1929.

ART. 26. In the case of operations of war between the land and sea forces of the belligerents, the provisions of the present convention shall only apply to the forces actually on board ship.

Any forces landed shall at once become subject to the provisions of the Geneva convention of July 27, 1929.

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This article states clearly the application of the two conventions, a matter which has caused considerable confusion in the past. It is a matter of the location, whether on land or on ships, and not of the class of personnel.

ART. 27. It shall be the duty of the commanders in chief of the belligerent fleets to provide, in detail, for the execution of the foregoing articles and also to deal with cases not therein provided for, in accordance with the instructions of their respective governments and in conformity with the general provisions of the present convention.

This repeats article 19 of the Hague convention. In the past, governments have taken occasion, on entering a war, to issue regulations for the guidance of their naval forces, interpreting the provisions of the treaties then in force. Quite naturally, the regulations of different nations differed somewhat, and this has caused some confusion. The last sentence of this article implies a hope that cases not specifically covered will be decided on a basis of humanity.

ART. 28. The high contracting parties shall take the necessary steps to instruct their navies, and especially the personnel protected, in the provisions of the present convention, and to bring them to the knowledge of the general public.

This repeats article 20 of the Hague convention. In times of peace these treaties are largely forgotten, and a very complete ignorance of their provisions prevails. This general ignorance has undoubtedly been the cause of certain abuses and violations in the past.

ART. 29. Belligerents shall remain free to enter into any *ad hoc* agreements, over and above their obligations under the present convention, which they may think fit.

This new provision would authorize additional agreements between belligerents. It has great possibilities for good. Such agreements might well include the stationing of neutral observers or control officers on hospital ships; protection of medical supplies being transported to sanitary formations overseas; protection for ships transporting civilian refugees; special hospital areas protected from air or chemical attack, and other humanitarian arrangements for which need might arise.

Consideration of the treaty in relation to the proposed revision cannot be complete without contrasting the destructive ideal of war with the humanitarian ideals which have motivated the Hague and Geneva treaties. On the one hand we have the objective of imposing the will of one nation on another by every possible destructive and punitive measure that will help to force the other to submit. This includes destruction of factories, water works, power plants, store houses, and transportation facilities with the purpose of weakening the enemy's power of resistance. Modern warfare, as witnessed in China, Abyssinia, and Spain, has shown that such destruction plays a very important part in the general scheme of operations. If the

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civilian population has suffered, that has been considered no disadvantage, or even an advantage, helping to break down the will to resist.

On the other hand we have the desire to reduce suffering, to salvage the sick and wounded, to rescue the shipwrecked, and to conserve manpower, to remove from the fighting units the incubus of sick men.

These two forces will always be opposed to each other. If the humanitarian idea, as portrayed in the treaty and the suggested revision, is to prevail, it can be effected only by a government which is convinced of the desirability of faithfully observing the provisions of the treaties. Each belligerent must be convinced that the enemy will scrupulously observe both the letter and the spirit of the agreements. Will this condition exist? We all hope so, but one cannot fail to observe that the general trend of the moral standards of governments is definitely downward. Treaties are signed by plenipotentiaries with their tongues in their cheeks, and are broken almost before the ink is dry. The only force that will secure observance of the treaties is the conviction that the government has more to gain by observing it than by abusing it. The nation that is fighting with its armed forces far from home will benefit most from the treaty, for it will provide safe carriage by water from the seat of war to the home ports. The nation situated close to the scene of action will be under the greatest temptation to break the agreement.

Advantages of Proposed Revision

1. The protection of the treaty is extended to the shipwrecked.
2. It clarifies the status of the sick, wounded, and shipwrecked of a belligerent, who are landed in a neutral port by certain types of vessels.
3. It authorizes the landing of patients from a belligerent warship in a neutral port and provides for their internment.
4. It extends the privileges of stay in neutral ports to all three classes of hospital ships.
5. It requires vessels once notified as hospital ships to remain in that status for the duration of hostilities.
6. The immunities of hospital ships are extended to include their crews and personnel trained as stretcher bearers or attendants.
7. It prescribes the rights and privileges of aircraft attached to hospital ships or used for medical transport.
8. The distinctive painting is made uniform for all types of hospital ships.
9. Belligerents who are signatories would be obligated even though not all belligerents had ratified the treaty.
10. It provides for additional agreements between the belligerents, in addition to the provisions of the treaty.

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Defects of Proposed Revision

1. The status of men landed in neutral ports from hospital ships is not made clear.
2. The special protection and facilities enjoyed by neutral ships which take patients on board (art. 8) should be clearly defined.
3. It should be clearly stated, whether or not hospital ships whose officers and men are combatants are protected under the treaty.
4. Definite provisions should be made for transportation of medical supplies for sanitary organizations operating at a distance overseas.
5. It should be definitely stated that hospital ships can be ordered to withdraw only after being stopped and visited by an enemy warship.

Conclusion

This proposed revision of the Hague Convention appears to possess very definite advantages as well as serious defects. The defects are largely those of omission. Considering all the conflicting viewpoints and interests of the nine nations and three international societies which were represented on the commission, it appears that a really constructive work has been accomplished, and, the positive virtues of the revision far outweigh its deficiencies. It is most desirable that it be made into an international treaty before the advent of the next general war. If this cannot be accomplished, it is to be hoped that the belligerents will, on the opening of hostilities, announce their adherence to the revision of the Hague Convention.

MEDICAL CARE OF DEPENDENTS OF NAVAL PERSONNEL

By Commander R. D. McMorries, Medical Corps, United States Navy

The medical care of dependents of naval personnel is an activity of the medical department that is still in a formative period and presents a problem about which little has been written.

It is not the purpose of this article to go into a discussion of gynecology, obstetrics, and pediatrics but to give the reader an idea of the present scope of this type of work, enumerating, with comment, some of the problems encountered, and certain deductions drawn.

Navy Regulations, paragraph 1185 provides that—

(1) Medical officers on duty at navy yards and naval stations will, in addition to their official duties, be required to attend the families of officers and enlisted men, including those transferred to the Fleet Naval Reserve after 16 or 20 years' naval service and those on the retired list, residing in the yard or station, or within 1 mile of the naval dispensary, except as noted in paragraph 4.

(2) Medical officers on detached duty, such as recruiting, may be designated by the department to attend officers and enlisted men and their families residing within 2 miles of their office.

(3) Except in cases of emergency, the medical attendance contemplated in paragraphs (1) and (2) will be available only during the regular working hours

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of the yard, station, or office, and provided it may be accorded without interference with the medical officer's other duties.

(4) Medical attendance will be accorded the families of officers on duty in Washington, D. C., not otherwise provided for, and retired officers and their families, who reside within 2 miles of the Navy Department.

(5) The family of an officer or enlisted man shall include only those relatives who are dependent upon him for support, and not persons employed by him.

(6) Officers and enlisted men will exact of their families consideration in their relations with medical officers, requiring those who are physically able to visit the dispensary, if there is one on the station.

In recent years the demand for medical service to dependents has increased so rapidly that it has become necessary to extend the boundary beyond the 1-mile limit prescribed by regulations; and today this work requires the full-time services of a large number of medical officers, nurses, and hospital corpsmen attached to shore stations.

The types of service accorded to dependents usually consist of office consultations, treatments and examinations, home visits, hospital care, when required, in naval or civilian hospitals.

The volume of work performed by the out-patient departments of naval dispensaries and naval hospitals, can be appreciated best by citing statistics from four of the larger activities for the year of 1938, as tabulated below:

Place	Office consultations	Home visits	Operations	Confinements
Naval Hospital, Norfolk, Va	12,240	788	515	242
Naval Dispensary, Washington, D. C	31,503	11,626	138	126
Naval Dispensary, Long Beach, Calif	48,558	3,821	3,591	632
Naval Hospital, San Diego, Calif	82,739	1,447	1,642	835
Total	175,040	16,235	5,888	1,835

To handle the volume of work created by care of dependents, in a capable and efficient manner, is one of the many problems that confronts the medical officers detailed to this duty. Some of these problems are common to all activities, while others are local and are influenced by the geographical location, composition of the personnel, available medical officers, hospital facilities, relief organizations, etc.

One problem that is common to all activities is the need for sufficient medical officers who have had special training in obstetrics, gynecology, and pediatrics. Medical officers detailed to this type of work should possess more than the professional qualifications. Tact, diplomacy, physical endurance, and personality are valuable assets, and a sense of humor go a long way toward keeping one on an even keel.

A staff composed of medical officers with these qualifications make a balanced staff and results in a more or less even distribution of the

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work. It not infrequently happens that one medical officer will have the bedside manner that patients like, with the result that his services are in greater demand and the work thrown on him is out of proportion to that done by some of the others who lack his favorable disposition. Patients loose sight of the fact that while they may be entitled to medical care they are not entitled to the choice of the doctor.

Medical officers detailed to family practice may expect to find the work exacting, arduous, and demanding, often requiring a sacrifice of rest, sleep, and recreation. Yet there are compensations in the satisfaction of work well done and the making of lasting friends. It seems that in this work the medical officer does not meet that barrier of official reserve that so many patients in a naval hospital maintain to the extent that they cease to be patients and become cases. In the out-patient work you know your patients, their emotions, their problems, as well as their physical ills. All of which go to make up the imponderables of medicine. No greater school of human nature exists than the one encountered in the out-patient work.

The definition of a dependent, or one who is entitled to medical care by the medical officers of the Navy, has often given rise to misunderstanding. According to the Judge Advocate General the term dependent shall include a lawful wife and unmarried dependent children; also the mother of the officer, nurse, or enlisted man, provided she is in fact dependent on him for chief support.

Another problem common to all activities is a means of identification of dependents. In a busy clinic, time does not permit the verification of a verbal claim to dependency. Yet it is important that only those receive treatment who are entitled to such. Otherwise an additional load is thrown on the staff, who, in most cases, are taxed to their capacity, the maintenance cost of the activity is increased, and civilian physicians find grounds for complaint.

A number of methods have been tried, such as the presenting of commissary cards or a letter from the service man's commanding officer certifying to the dependency. Small identification cards verified by proper authorities have also been used. None of these methods are entirely satisfactory, but they help reduce the number of ineligibles who may apply for treatment.

Good roads and modern transportation facilities have opened up new and distant residential sections to naval personnel with the result that the areas covered by the medical officers in making house calls have increased until it has become necessary to set certain limits outside of which calls will not be made. The area to be covered is a local problem and should be governed by the number of dependents attached to the station, the number of available medical officers, and the transportation facilities, ambulances, official cars, etc.

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The number of house calls that one medical officer can make in a regular working day depends somewhat on the area to be covered and on the grouping of the calls, also on the amount of traffic to be encountered. A rather careful survey shows that two and a half calls per hour are the maximum that can efficiently be handled, and in a city like Washington, D. C., where the area to be covered is large and the traffic congested, one and a half calls per hour will keep one busy.

The request for house calls is the most abused of the services rendered. Patients often find it more convenient to have the doctor come to their homes than for them to go to the dispensary, although they may be physically able to do so. To limit house calls to those necessary is another of the many problems that confront the out-patient doctor. This is particularly true of night calls and calls after hours, when only emergencies are supposed to be seen. The responsibility of determining whether a call is a necessary call or an emergency call, should rest with the medical officer receiving the call and not with the patient or the person placing the call. But it is better to make many unnecessary calls than to fail to make one that is necessary.

To make a small charge for house calls as a means of defraying expenses for transportation, and to curtail unnecessary calls, has been suggested but this has not been feasible, since there has been no way by which such a fee could be collected or credited.

The importance of keeping medical records is unquestioned. The need of some type of uniform record in the out-patient department is apparent when one peruses the different types now in use at the different activities. Hospital records are uniform and standardized to meet the requirements of the American College of Surgeons, but the records in the out-patient departments are varied in kind and completeness.

Some form of an abstract that would include such data and dates as diagnoses of former illnesses and treatments, vaccination records, immunity records, operations, birth recording, and dependency identification, would facilitate complying with request for such data by another activity to which the patient may have applied for treatment. It would also furnish identification and remove the necessity of having to establish dependency at each station to which transferred. It often happens that a patient presents herself at a clinic with certain symptoms, the history and examination reveal there has been an abdominal operation, but the patient does not know whether it was "the right tube and left ovary removed or the left tube and the right ovary removed or maybe it was both tubes removed." Writing for the operative record causes delay and such delay is often annoying to the patient who firmly believes the scar should tell the nature of the operation.

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The demands made upon the various departments of a naval hospital by the out-patient department are great. This is particularly true of the x-ray, physiotherapy and laboratory, although the cardiography and metabolic laboratories get their share. In a busy hospital this is quite an additional work load and an added expense. It is not uncommon for patients who are under the care of civilian physicians to come to the out-patient departments and request gastro-intestinal pictures, basal-metabolism tests, gall-bladder studies and blood work, the reports to be sent to their private physician. The question arises whether or not a dependent should be accorded this service unless they be under the care of a naval medical officer. The same thing applies to the compounding of prescriptions written by civilian physicians.

During the last few years certain naval hospitals have been designated to admit dependents of naval personnel, active and retired. The charge for such hospitalization to be $3.75 per day. Of this amount 75 cents a day is charged for the patients ration and the balance goes to hospitalization fund in the custody of the ship's service store to defray the expenses of hospitalization. This has solved the problem of hospitalization of dependents for personnel of those activities so designated, but on other stations, the problem of adequate hospitalization for dependents within the financial reach of officers and men remains unsolved.

In the absence of any special allotment to defray the expenses of the out-patient departments, the cost of operation is borne by the hospitals and dispensaries, and except for patients who are hospitalized, there is no charge. Clinic patients pay nothing for drugs, dressings, or materials used except in a few hospitals there is a charge for x-ray films and nonsupply table drugs and for animals used in certain laboratory tests.

Hospitals authorized to admit dependents employ civilian nurses and charwomen and these hospitals are dependent on the money received from patients admitted to pay the salaries of the nurses and charwomen, and for equipment, special drugs, etc. Yet the services of these civilian nurses are used in the routine care, examination, and treatment of clinic patients who pay no part in the upkeep of the clinic. Unless the patient load is sufficient, the revenue derived from hospital cases will not cover the expenses and the activity must appeal to the Navy Relief Society, ship's service store and to individuals for contributions in order to continue to function since these clinics are required to be operated at no cost to the Government.

On some stations medical aide societies have been organized. Membership is voluntary, dues are paid monthly according to the rank and pay grade of the member. Membership in the society entitles the member's family to medical treatment in the clinic and

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to hospitalization when required. Under this plan when a dependent is admitted to the hospital the service man will be required to make a deposit of $3.75 a day for the total number of days estimated by the medical officer as the probable duration of the patient's stay in the hospital. Of the above amount 75 cents per day goes for the ration and no part of it is recoverable. The commanding officer may spend whatever part of the remaining $3 he deems necessary for nurses hire, special medications, etc., and refund any balance there may be left. Nonmembers pay the full rate of $3.75 a day. In this way all members, whether admitted to the hospital or not, help pay the expenses of the out-patient clinic.

If this, or some other method, could be made applicable to all dependents eligible for medical care, it would help solve the problem of financing family clinics. If congressional authority could be obtained to allow the checkage of one-fourth of the per diem pay of the officer or enlisted man for each day of hospitalization of the dependent, it would scale the rates and remove the objection that the seaman pays the same rate as the admiral, and it would assure of 100 percent collections.

Again, if with the approval of the Navy Department and the authority of Congress, an additional 30 cents a month could be checked against the pay of each officer and enlisted man, active and retired, with dependents, it would probably assure ample funds to maintain all the out-patient departments independently of any other source of revenue. This 30 cents per month would be in the form of a medical insurance premium and would entitle the dependent of the officer or enlisted man to hospital care for a fixed number of days per year and to unlimited clinic visits and medication. The number of days of hospitalization to which a dependent may be entitled per year would have to be determined by proper authority. Upon admission to the hospital of a dependent, the officer or enlisted man responsible for payment would be required to deposit 75 cents per day for the ration for each day of hospitalization. If hospitalization required longer than the fixed number of days to which his dependent was entitled, then the officer or enlisted man would be required to pay the regular rate of $3 per day, in addition to the 75 cents for ration, for each day over the authorized number of days. Thus for $3.60 per year, plus 75 cents a day for ration, an officer or enlisted man would be entitled to have his dependents hospitalized for a specified period of days—21 for example—each year if such were required.

No article on out-patient work would be complete without some mention of the Navy Relief Society. This organization has become intimately associated with the out-patient departments of naval hospitals and dispensaries. It has rendered invaluable services to both patients and doctors. Hundreds of dependents of naval personnel

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have been able to secure urgent and necessary hospital care through the generous financial aid of Navy Relief. Visiting nurses have been provided at some hospitals to care for patients after their return home. Nurse maids to care for the children during the mothers absence in the hospital have been furnished, and countless other acts performed, all of which have helped the patients concerned and have relieved the busy medical officer of the necessity of dealing with a multitude of these domestic problems.

The out-patient departments have done much to acquaint the naval service as a whole with the medical department.

The rapid growth of the out-patient work, and the volume of work now being done by these departments, as shown by the figures given, is proof positive that the work is appreciated by the service personnel and that it is being done in an efficient and capable manner. It may be safely predicted that the work of the family clinics will continue to increase.

The officers and enlisted men may now go to sea secure in the knowledge that, in case of illness or injury to a member of his family, medical and surgical care will be provided efficiently, expeditiously, and as cheaply as possible.

To insure the continued efficiency of the constantly growing out-patient departments is the desire of the medical department.

It was with this in mind that the problems mentioned in this article were dwelt upon, in the hope that some satisfactory solution might result, and that the medical care of dependents of naval personnel might be put on a uniform basis on all stations.

SURGICAL CARE OF DEPENDENTS OF NAVAL PERSONNEL

By Commander C. M. Shaar, Medical Corps, United States Navy

The out-patient departments of naval hospitals and dispensaries have opened a new field to the naval surgeon, a field that has carried us to the domain of the civilian surgeon. Two decades ago our surgical problems seldom involved congenital diseases of the new born, orthopedics in children, gynecological surgery, obstetrics, and pediatrics. Today many of our medical officers devote a tour of duty ashore in this important work in the care of the dependents of naval personnel. The purpose of this article is to present the trials and triumphs of the naval surgeon in this new and important field of endeavor. It is a plea for a complete understanding of its magnitude and possibilties. To be able to perform the task efficiently, and with credit to ourselves and the corps, we must be well prepared as general surgeons and not as surgical specialists. The wealth of material is considerable and the opportunities for training the younger medical officers are vast. It is of interest to note that this work began not

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many years ago by medical officers assigned as family doctors at various stations. Their splendid work, the confidence that they earned and merited, laid the foundation and opened a new field that has increased our usefulness.

The naval surgeon, who is well versed in general surgery, will find a wealth of material in the clinics of our out-patient departments. Here is congenital pyloric stenosis, intestinal obstruction in infants, hydrocephalus, cleft palates, ruptured ectopic pregnancies, and various types of traumatic surgery. But if the surgeon is not prepared he will find himself shrinking from these responsibilities, haunted by anxieties, baffled by perplexities, and numberous self reproaches of one who is not properly trained. The duty in this field is a test of personal ability and integrity and we must be worthy representatives of our corps in the eyes of the patients and our civilian colleagues.

It has seemed to me appropriate to mention briefly something of the administration of the Long Beach Dispensary. The separate command has distinct advantages. The concentration of effort, the independent organization and the less likelihood of shifting the personnel adds considerably to the efficiency of the staff and the increase in the quantity and quality of the work. It creates a field all its own. It becomes a real clinic. A clinic composed of specialists each responsible for his own department and working with an enthusiasm to elevate it to the highest ideal and proficiency. The amount of clinical work performed during the year is reflected in the following summary—totals for the calendar years 1936 and 1937 being included for comparison:

	Total		
	1938	1937	1936
(A) CIVILIAN HOSPITALS			
(a) Total admissions to hospitals	2,531	2,151	1,754
(b) Total sick days	22,746	15,011	13,102
(c) Major operations	1,080	745	502
(d) Minor operations	1,106	1,143	986
(e) Tonsillectomies	221	343	308
(f) Confinements	632	671	637
(g) Deaths (all causes) (dependents)	29	37	36
(B) DISPENSARIES			
(h) Office consultations	48,558	53,305	64,997
(i) Antiluetic treatments	11,685	10,199	13,135
(j) Minor operations (home or office)	1,405	1,295	1,141
(k) Laboratory examinations	21,738	24,243	19,933
(l) X-ray examinations	16,160	20,609	19,327
(m) Prescriptions	32,854	37,380	49,726
(n) Physiotherapy treatments	8,712	8,195	8,628
(o) Eye refractions	1,146	1,211	1,464
(p) Cystoscopic examinations	43	60	144
(q) Baby clinic	2,391	2,355	2,636
(r) House calls	3,821	5,075	5,174
(s) Elliott treatments	2,660	1,636	649
(t) Basal metabolic tests	442	450	429
(u) Electrocardiograph tests	251	175	211
(v) Physical examinations, miscellaneous (not dependents)	518	270	220
(w) Naval dead cared for	42	40	85
(x) Hypodermic treatments	10,746	11,632	0
(y) House calls—visiting nurse	465	0	0

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The appointment system has solved one of our most difficult problems. In his annual report for 1938 Captain Melhorn stated:

Until the institution of the appointment system in April, the constantly increasing number of persons requesting medical service of the Long Beach Dispensary presented an exceedingly difficult problem. With waiting rooms crowded daily to capacity (many times overflowing to corridors), clinics not large enough to permit cubical arrangements, the demands on personnel and equipment often proved impossible to meet.

There being no short cut in medicine except one that passes too close to error in diagnosis and treatment, any compromise with this requirement inevitably exacts a toll of mistakes and dissatisfied patients. To prevent overloading of certain members of the staff and unequal apportionment of work, administration must interest itself in and control allocation of patients. To that end the appointment system for clinical service was established on April 1. A marked improvement in service resulted at once—an improvement which has continued without interruption. The demands on clinics are now kept within limit of their facilities.

Except for emergent cases all clinical work in each dispensary since April 1 has been conducted on appointments arranged in advance—15 minute periods for each patient being scheduled, unless the medical officer concerned directs a longer or shorter period be allotted for an individual patient.

On the day that a staff officer is officer of the day no appointments are scheduled for that officer as he is engaged in treating the "extra" patients (those who come to the dispensaries without a prearranged appointment).

In the interest of providing modern medical care in all that that term implies, we have found that the appointment system is a primary essential. The patient, once in the dispensary, should not have to wait hours before he or she can be given service. If the dispensary is efficiently conducted and the appointment system utilized, hours lost by the patient in waiting can be reduced to a minimum. These factors which save time for the patient are important in maintaining his or her cooperation. We know of many instances in which poor cooperation of the patient was directly due to lack of facilities for promptly serving the patient.

It is our belief that an appointment system, i. e. administrative control, similar to the one employed here is the answer to the frequent query: "What is to be the limit of dispensary and out-patient service?"

A word regarding administrative control. As a result of frequent surveys by the medical officer in command and the senior medical officer of the San Pedro Dispensary, the maximum daily patient load for maintaining good clinical work in each clinic has been determined. Staff medical officers are directed not to exceed that maximum except in the care of emergent cases which receive priority service. Quality of clinical work rather than quantity is the primary consideration.

Since the appointment system was instituted the results have been pleasing to patient and doctor alike because of improved service—a service which endeavors to conserve the health of the physician as well as the patient.

The medical social service is indispensable to our out-patient departments. It is useful to administration and clinician alike. The realization of its importance and the employment of its services have lightened our task considerably. Captain Melhorn tells us that:

No subject in human experience offers more fruitful opportunity to observe intense emotion than that of medical social service. An integral part of our organization, unfailing in cooperation with administration and clinician, this

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department ranks second to none in results attained. With quiet efficiency it goes about its daily task of finding solutions for economic and social problems which handicap or prevent effective therapy, instructing patients who have acquired syphilis or gonorrhoeal infections, contacting local relief agencies, investigating and reporting upon failures of patients to keep appointments, following up within 24 hours and reporting upon complaints with respect to medical care.

The volunteer social service in Long Beach area is rendering a splendid help—the Navy Relief Society, the Navy Doctors Wives Club, the Navy Officers Wives Club, the Thrift Shop, and the Navy Wives Club. Their help to the needy Navy families made many a medical problem easier to solve.

Two recent additions to the organization of the Long Beach Dispensary have proven of great value: The domiciliary medical service and the visiting nurse service.

A staff medical officer is assigned to the domiciliary service for a period of 3 months. His chief duty is to respond to home calls including obstetrical and post-operative patients who were discharged from local hospitals to complete their convalescence at home. In 1938 a visiting nurse service was financed by the Navy Relief Society. This service has augmented the domiciliary service and has proved to be of great value. The establishment of these two services has given prompt and efficient treatment to the sick at home. In many instances they obviated the necessity for hospitalization and thereby decreased the financial burden.

During 1938 two medical officers were assigned to the Long Beach Dispensary for postgraduate instruction in gynecology and obstetrics. The instructional schedule includes practical experience in the following subjects: Preliminary medical examination for gynecologic patients, gynecology, clinical and operative; abdominal surgery, clinical and operative; prenatal clinic, pelvimetry, obstetrics clinic, pelvic diagnosis and forceps application, disease of mammary gland, eye grounds in toxemia, anesthesia, blood transfusion, and surgical pathology.

The field of general surgery in the out-patient department is vast and its problems are varied. A brief review is presented from the work referred to surgery by the obstetrical, pediatrical, and gynecological services. The general surgery cases will be omitted as they are familiar to all of us in our naval hospitals.

Six cases of ruptured tubal pregnancy were submitted to operation. The ages varied from 21 to 35 years. A history of pelvic infection was given in five of the cases and evidence of a chronic pelvic infection was found at time of operation in the sixth case. Symptoms and diagnosis were strongly suggestive of pregnancy and definite as to internal hemorrhage. Shoulder pain was associated with fainting, localized pain and vaginal bleeding in five cases. Aschheim-Zondek

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test proved positive in five cases. Sedimentation time showed a rate of 30 to 35 minutes. Recovery was uneventful in all these cases and hospitalization averaged 12 days.

The obstetrical service referred 30 cases for cesarean section in a period of about 2 years, representing 2.14 percent of the 1,400 obstetrical cases for this period.

Incidence of cesarean section

	1937	1938	1939	Total
Obstetrical cases—Long Beach	481	471	75	1,027
Obstetrical cases—San Pedro	190	161	22	373
Total				1,400
Cesarean section—Long Beach	13	7	4	24
Cesarean section—San Pedro	0	5	1	6
Total				30

Percentage of cesarean sections, 2.14.

Indications for cesarean section

Disproportion	12
Pre-eclamptic toxemia	10
Placenta previa	4
Abnormal, large head	1
Abnormal position which could not be corrected	1
Serious exhaustion of the patient	2

All these patients recovered—28 left the hospital between 10 and 12 days—2 cases had a stormy convalescence from streptococcic infection. Both cases responded well to sulfanilamide and their eventual recovery was complete.

The pediatrical service referred the following interesting cases:

Congenital pyloric stenosis	12
Torticollis (congenital)	2
Spina bifida	4
Cleft palate	2
Hare lip	3
Branchial cysts	1
Wilms' tumor	1
Meckel's diverticulum with perforation and peritonitis, 10 months of age	1
Intestinal obstruction—congenital defect—1 day old	1
Hernia to the umbilical cord with strangulation few hours after birth	1

These cases were submitted to operation. Recovery was uneventful except in two cases. A baby 10 months old was operated on 2 days after onset of symptom but 2 hours after he was seen at the clinic. Operative findings: General peritonitis from a perforated Meckel's diverticulum. Baby died 2 days following operation. Autopsy confirmed operative findings.

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The second case, a Mongolian idiot baby 1 day old, developed intestinal obstruction due to congenital malformation in small intestines and mesentery. Operation was performed and 18 inches of intestines were resected because of gangrene. Baby lived for 1 week. These unusual and very interesting cases will be reported in detail at a later period. The following cases are under treatment:

Hydrocephalus	3
Congenital absence of auricle—right ear	1
Congenital malformation—right ear	1
Congenital malformation hands	1
Talipes equinus following infantile paralysis	3
Talipes varus congenital	2
Talipes valgus congenital	2

Gynecological work in the out-patient department is one of its most important activities. The following is a brief summary of gynecological operations performed in a period of 2 years:

Coloplasty, cystocele	12
Hysterectomy:	
Uretine fibroids	43
Carcinoma, uterus	1
Prolapse, uterus	11
Persistent menorrhagia	8
Oophorectomy for ovarian tumor:	
Multilocular cyst adenoma	6
Teratoma	13
Endometrioma	5
Perineorrhaphy, rectocele	72
Repair:	
Vesicovaginal fistula	1
Rectovaginal fistula	2
Salpingectomy—for chronic pelvic inflammatory disease	124
Salpingo-oophorectomy—for chronic pelvic inflammatory disease	39
Salpingostomy or salpingoplasty for sterility—for chronic pelvic inflammatory disease	100
Suspension of uterus for retroversion and retroflexion with symptoms	68

One hundred operations were performed for sterility the result of chronic salphingitis. A careful study was made to rule out other causes of sterility. The following points were of special interest:

(1) Rubin test proved negative in all this group.
(2) The husband was examined before the wife was submitted to operation.
(3) History of sterility extended from 2 to 12 years.
(4) Ages varied from 21 to 35 years.
(5) Careful pre- and post-operative treatments for several months.
(6) Fifteen of this group became pregnant and delivered normal babies.

This interesting group will be reported at a later date when sufficient time has elapsed to determine the successes and failures.

The chronic gonorrheal salpingitis cases presented a group of symptoms common to most of them. They appeared prematurely aged,

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haggard, nervous, and irritable. They complained of headache and sacral backache. Most of them complained of dull, dragging sensation in the lower abdomen or in one of the iliac regions. Some complained of actual pains in these regions. The pain is aggravated by exertion, may be continuous or there may be short intermissions in which the patient is free from pain. There is a secondary dysmenorrhea with menorrhagia or metrorrhagia. Very few suffer from amenorrhea, but most of these patients are sterile. The symptoms are due largely to extensive adhesions but there are many cases of sterility that are free from other symptoms.

OBSTETRICAL CARE OF DEPENDENTS OF NAVAL PERSONNEL[1]

By Commander John R. Porter, Medical Corps, United States Navy, and Lt. Paul Peterson, Medical Corps, United States Navy

The object of this analysis is the presentation of results from an activity which is seldom represented in the Bulletin, namely, obstetrics. It is the purpose of this article to give as briefly as possible a detailed analysis of the method of handling, complications, results, etc., of some 2,378 naval obstetrical cases cared for at the Mercy Hospital, San Diego, Calif., from July 1, 1934, to July 1, 1938. This period is chosen since the senior author was in charge of this department during that time. During this period there were interns and postgraduate students on the service. One of the authors was scrubbed for all deliveries done by the interns, and for all operative deliveries done by the postgraduate students.

Unfortunately, due to the fact that all abortions (under 5 months) were handled on a separate floor and usually by a different staff, no figure is available on the abortion cases.

The obstetrical and pediatric activities are growing rapidly since more men are being trained for this service and are being left long enough in one place to establish themselves. The naval out-patient department is now beginning to hold its own with the civilian clinic. The figures in table 1 show briefly the growth of this clinic.

TABLE 1

Pediatric and obstetrical yearly visits July 1, 1934–July 1, 1938

Year	Obstetrical clinic			Pediatric clinic		
	New cases	Revisits	Total	New cases	Revisits	Total
1934	[1] 203	[1] 1,116	[1] 1,319	[1] 347	[1] 1,082	1,429
1935	839	3,387	4,726	778	2,597	3,375
1936	891	5,194	6,085	806	3,424	4,230
1937	976	6,657	7,633	844	3,822	4,666
1938	[1] 598	[1] 4,421	[1] 5,019	[1] 428	[1] 2,070	2,498

[1] Represents only 6 months of the year.

[1] From the naval clinic of the Mercy Hospital, San Diego, Calif.

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From the foregoing table it may be seen that there has been a steady increase in both the obstetrical and pediatric clinic each year. The great discrepancy between the new obstetrical cases admitted (3,507) and those actually delivered (2,378) can be credited to transfer of the husbands to other stations before the patient delivered, with a small percentage due to abortions, either induced or spontaneous.

Table 2 shows the number of deliveries and circumcisions per month for each year. Permission for circumcision was always obtained before it was done. Seldom did a mother refuse her permission. Such a procedure proved very satisfactory, and it has been noticed that babies coming to the clinic from places where circumcision had not been done were for circumcision. The procedures listed here are only those done on newborn babies.

TABLE 2

Deliveries and circumcisions

Month	1934		1935		1936		1937		1938		Total	
	D	C	D	C	D	C	D	C	D	C	D	C
January	------	------	21	15	44	30	41	25	55	30	155	106
February	------	------	14	9	32	17	29	12	50	30	125	68
March	------	------	39	13	41	22	55	23	66	24	201	82
April	------	------	31	16	53	31	54	37	57	30	195	114
May	------	------	27	2	57	28	48	23	85	43	217	96
June	------	------	37	13	60	35	61	31	80	45	238	124
July	22	8	47	23	60	38	71	29	------	------	200	98
August	27	8	71	48	60	27	58	30	------	------	216	113
September	27	14	58	32	71	41	81	37	------	------	237	124
October	25	11	68	32	52	36	51	24	------	------	196	103
November	26	8	53	11	44	21	50	26	------	------	173	66
December	39	19	55	26	56	28	75	37	------	------	225	110
Total	166	68	515	246	630	354	674	334	393	202	2,378	1,204

D=deliveries. C=circumcisions.

Tables 3 and 4 show the number of cases of each position in both primiparas and multiparas. The figures here shown do not correspond with those listed in text books. The following are those given by DeLee in 48,449 cases in which 70 percent were O. L. A.; 29 percent O. D. P.; 1 percent O. L. P. and O. R. A.; 0.7 percent transverse; 0.6 percent face; and 2.7 percent breech.

The manner in which the posterior positions were delivered will be taken up later.

Of the face presentations, one was a chin posterior and required version and extraction. The other was chin anterior and delivered as such without undue concern.

The transverse positions were rotated where possible to either breech or cephalic and labor allowed to progress. When rotation could not be accomplished, section was usually the means of delivery chosen to conserve both the mother and the baby.

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TABLE 3

Position at delivery

Position	Gravida I (cases)	Gravida II+ (cases)	Total	Percent
O. L. A	644	652	1,296	54.5
O. L. P	73	45	118	4.9
O. R. A	342	328	670	28.2
O. R. P	109	65	174	7.3
Breech	63	44	107	4.5
Transverse	7	4	11	.4
Face	1	1	2	.08
Total	1,239	1,139	2,378	

The breech deliveries caused no great concern as most of them were delivered by Potter's technic or the Morriseau-Snelly-Veight maneuver. Only one breech of 107 was lost for a mortality of 0.9 percent which is far less than the average mortality of 10 to 15 percent. Forceps to the aftercoming head were used whenever necessary. Two facts are of especial significance: (1) That those patients were not too deeply narcotized and local perineal block was done so that voluntary effort could be used, and (2) delivery was not rushed. No doubt rushing at the time of delivery kills as many babies in breech delivery as any other single factor. This is due to sudden release of pressure on the fetal head after a rapid compression. Should the baby aspirate amnionic fluid a tracheal catheter can be used to remove it.

TABLE 4

Posterior positions delivered as such

Position	Gravida I (cases)	Gravida II+ (cases)	Total
O. R. P	20	12	32
O. L. P	21	12	33
Total	41	24	65
Manual rotation	56	29	85
Forceps rotation	5	1	6
Spontaneous rotation	65	45	110
Delivered by cesarean section			26

Table 5 shows that the majority of the primiparas delivered under 12 hours, and the multiparas under 6 hours. One primipara delivered after 85 hours and one multipara after 80 hours. Many of the multiparas delivered within only a few minutes. It is believed that proper sedation shortens the total labor rather than prolongs it, if prophylactic, low forceps are used rather than waiting for voluntary expulsion of the baby.

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TABLE 5

Length of labor

Hours	Number		Hours	Number	
	Gravida I	Gravida II		Gravida I	Gravida II
1	3	54	34	2	6
2	16	99	35	2	2
3	38	114	36	10	1
4	60	144	37	1	
5	62	117	38	5	
6	91	112	39	1	
7	93	59	40	3	1
8	72	82	41	1	
9	61	51	42	1	
10	75	46	43	4	
11	41	35	45	1	1
12	109	33	46	5	
13	50	28	47	1	
14	44	18	48	3	1
15	46	13	50	2	1
16	45	12	51	1	
17	28	15	52	3	1
18	38	8	53		1
19	24	7	54	2	
20	23	12	55	2	
21	28	5	56	2	
22	18	8	58		1
23	20	1	60	2	
24	29	5	62	2	
25	11	4	72		1
26	7	2	80	1	1
27	7	2	85	1	
28	11	2	Not recorded	29	22
29	8	3			
30	6	1	Total	1, 239	1, 139
31	3		Grand total	2, 378	
32	8	1			
33	4	2			

Sedation and types used.—Table 6 gives a complete list of sedation used in 2,327 cases, including cesarean sections. There were only 51 cases in which no sedation was used. The results on the whole were excellent. There were no fetal or maternal deaths traceable to the sedation as a primary cause. It was often necessary to use coramine, metrazol, or caffeine-sodio-benzoate as a stimulant. Alpha-lobeline was not used due to its depressing action on the circulatory system. The above-named stimulants were very effective and not depressing. Occasionally, coramine and metrazol caused twitchings in the various muscles of the body, and some observers have reported actual convulsions. For this reason caffeine-sodio-benzoate was given first choice. The coramine and metrazol were given in 1 cc. doses. The caffeine was given in from 4 to 7½ grain doses depending on the size of the baby.

For resuscitation of premature babies it should be emphasized that a warm-water bath is of untold value. An intratracheal catheter should always be handy and the accoucher should be adept at passing it. Various respirators are not as helpful and safe as the catheter. The pressure on the tracheal catheter should not exceed 20 mm. of mercury for fear of rupturing the lungs.

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The results of sedation in the mother were anywhere from poor to excellent. Some were very wild, others moderately so, while most women were perfectly quiet. Since analyzing the cases herein reported, still another combination has been used, and which has proven very satisfactory. It has been used in 193 cases with very gratifying results, and with a marked reduction in the use of prophylactic forceps. It is dial with urethane given intramuscularly in 2 cc. doses for two to three doses at hourly intervals until dilatation begins, and then evipal soluble in a 10 percent aqueous solution is given by rectum in amount of 0.15 cc. to 0.17 cc. per pound body weight. The patient usually sleeps quietly and will cooperate by pushing down during the second stage of labor. It requires considerable experience in the use of analgesia before satisfactory results can be safely attained, since some cases respond better to one combination and others to another combination. Certain cases can be brought into the hospital, given proper sedation, and then induced, and will go through labor without knowing anything about it at all.

TABLE 6

Analgesics and anesthetics used

Cyclopropane gas	6
Dilaudid, H. M. C., and evipal	1
Dilaudid and evipal	8
Dilaudid, evipal, and ether	9
Dilaudid, scopolamine, evipal, and ether	61
Dilaudid, scopolamine, H. M. C., evipal, and ether	5
Dilaudid, scopolamine, H. M. C., and ether	2
Dilaudid, and ether	5
Dilaudid, scopolamine, and ether	2
Dilaudid, scopolamine, and evipal	6
Ether	323
Ether and sodium amytal	6
Ethylene gas and ether	2
Evipal	34
Evipal and ether	49
Evipal and perineal block (1 percent novocaine)	1
Evipal, H. M. C., and ether	4
Evipal and H. M. C	1
H. M. C	54
H. M. C., paraldehyde, and ether	2
Local infiltration (1 percent novocaine)	1
Morphine, sodium amytal, and ether	1
Morphine and spinal (120 mgm. novocaine)	1
Morphine	4
Morphine and sodium amytal	1
Morphine, sodium amytal, paraldehyde, and ether	1
Morphine, paraldehyde, and ether	3
Nembutal	14
Nembutal and ether	360
Nembutal, H. M. C., and ether	100
Nembutal, scopolamine, and ether	20
Nembutal, scopolamine, H. M. C., and ether	24
Nembutal, H. M. C., spinal (120 mgm. novocaine) and ether	3
Nembutal, sodium amytal and ether	62
Nembutal, paraldehyde, and ether	968
Nembutal, paraldehyde	38
Nembutal, paraldehyde, H. M. C., and ether	60
Nembutal, paraldehyde, morphine, and ether	2

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Analgesics and anesthetics used—Continued

Nembutal, paraldehyde, and perineal block (1 percent novocaine)	2
Nembutal, H. M. C	1
Nembutal, paraldehyde, evipal, and ether	1
Nembutal, paraldehyde, H. M. C., evipal, and ether	1
Nembutal, paraldehyde, H. M. C., dilaudid, evipal, and ether	1
Nembutal, paraldehyde, dilaudid, evipal, and ether	1
Nembutal, evipal	2
Nembutal, perineal block with 1 percent novocaine	2
Nembutal, evipal, and ether	4
Nitrous oxide gas	1
Paraldehyde	1
Paraldehyde, sodium amytal, and ether	14
Paraldehyde and sodium amytal	2
Paraldehyde and ether	8
Perineal block with 1 percent novocaine	1
Scopolamine and ether	1
Sigmoidal, H. M. C., nembutal, and ether	4
Sigmoidal and ether	3
Sigmoidal	3
Sigmoidal, paraldehyde, and ether	1
Sigmoidal and perineal block (1 percent novocaine)	1
Spinal (120 mgm. novocaine)	35
Total	[1] 2,327
No analgesia or anesthesia	[2] 51
Grand total	2,378

[1] 19.7 percent.
[2] 2.2 percent.

From table 7 it can be seen that 52.1 percent of the total cases were primiparas. There were only 11 women who were more than gravida VI. The proportion of male to female babies closely parallels the reports of other series in the literature. Of this series, 51.4 percent were males.

TABLE 7

Sex and gravida

Gravida	Deliveries	Sex	Deliveries (male)	Deliveries (female)	Total	Percent
I	1,239	Gravida I	624	615	1,239	52.1
II	711	Gravida II+	599	540	1,139	47.9
III	294	Total	1,223	1,155	2,378	
IV	82	Percent	51.4	48.6		
V	25					
VI	16					
VII	4					
VIII	1					
IX	5					
X	1					
Total	2,378					

Of the 2,378 deliveries only 23.4 percent of the babies were born by normal, spontaneous labor. This can be seen from table 8. This figure sounds astoundingly low until one considers that it is exclusive

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of epistotomy, laceration, or prophylactic forceps. Perhaps more could have been delivered without an episiotomy, but there would have been more operations for rectoceole and cystoceole. Therefore, no apology for this seemingly low figure is considered necessary.

TABLE 8

Normal deliveries

Position	Gravida I (cases)	Gravida II+ (cases)	Total
O. L. A.	45	293	338
O. R. A.	24	134	158
O. R. P.	2	18	20
O. L. P.	3	6	9
Breech	3	13	16
Total	77	464	[1] 541

[1] 23.4 percent.

FORCEPS DELIVERIES.—Forceps are a great aid to the obstetrician in saving both the mother and the baby, but forceps to the average practitioner can, and only too often do, become a weapon with which the infant is maimed or killed and the mother is lacerated so that the perineum all but ceases to exist. Table 9 shows a detailed summary of the use of forceps in this series. Intracranial injuries to the infant will be given further in the report.

Of the primiparas (1,194) delivered from below, forceps were used in 44.05 percent. Of this number 34 percent were delivered by low or prophylactic forceps. Midforceps accounted for 9.9 percent, and those were largely on posterior positions which were rotated. There was only 1 high forceps delivery in the 1,194 primiparas or 0.09 percent.

In the 1,109 multiparas, forceps were used in only 9.2 percent of the cases; 7.3 percent were low forceps, and 1.8 percent were mid-forceps. High forceps were used for 1 of the 1,109 multiparas for an incidence of 0.09 percent.

The total for the series of 2,303 deliveries was 27.22 percent with 21.1 percent for low forceps; 6 percent for midforceps, and 0.08 percent for high forceps.

TABLE 9

Forcep deliveries

GRAVIDA I

Position	Low forceps	Mid forceps	High forceps	Total
O. L. A.	230	34	1	265
O. R. A.	112	11	0	123
O. R. P.	35	38	0	73
O. L. P.	24	35	0	59
Breech	5	1	0	6
Total	406 (34%)	119 (9.9%)	1 (0.09%)	526

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Forcep deliveries—Continued

GRAVIDA II+

O. L. A.	43	6	0	49
O. R. A.	16	2	1	19
O. R. P.	12	3	0	15
O. L. P.	8	9	0	17
Breech	2	0	0	2
Total	81 (7.3%)	20 (1.8%)	1 (0.09%)	102
Grand total	487 (21.1%)	139 (6.0%)	2 (0.08%)	628

PERSISTENT POSTERIOR DELIVERIES.—There were 266 posterior positions delivered from below. Table 4 shows the manner in which they were handled. It can readily be seen that most posterior positions were handled by manual rotation and forceps delivery. It is believed that such a procedure is by far the safest for the child and for the mother. Oftentimes a manual rotation is difficult to attain. When such a procedure is done a cephalic application of the forceps should always be made or else cutting or crushing injuries will result, especially to the baby.

The forceps rotations were either by Scanzoni or Kielland maneuver, and were done only when the head was too low to warrant pushing it up for manual rotation.

It can be seen that spontaneous rotation occurs in the larger part of the cases, and probably would have occurred in more cases had labor been allowed to go prolonged. Most cases were delivered after from 1 to 2 hours' full dilatation if spontaneous rotation had not occurred. This unquestionably saves both the mother and the baby, since more babies were lost by letting labor go ahead than by operative delivery. This procedure, however, is recomended only in skilled hands since untold damage can be done to mother and baby by improper application of forceps in the midpelvis.

INDUCTION OF LABOR.—It has only been within the past few years that induction of labor has been studied very thoroughly. Until recent pioneer work of a few outstanding men, induction of labor was looked upon as a dangerous procedure for both mother and baby. However, it has been shown that the induction of labor may be not only harmless but actually helpful in many cases. Many babies of toxic mothers can be saved by induction of labor before they die in utero of toxemia. Many patients should be induced before the baby gets extremely large. In this series there were 191 cases induced, or 8.3 percent, of the series. Lacerations of the cervix, perineal relaxations, infections, etc., have been no more frequent in these cases than in those going into labor normally, and the duration of labor has been cut about one-third. The fetal mortality has been no greater in this group.

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Induction is usually carried out as follows:

The patient is requested to enter the hospital at 0500 when she is given 2 ounces of castor oil. One and one-half to 2 hours later she is given a good soapsuds enema. At the same time quinine is begun in 1 grain doses, and is given every half hour until eight doses have been given. At the time of the last dose of quinine, the patient is prepared for sterile vaginal examination and the membranes ruptured with an Allis forceps. Pressure is made on the fundus of the uterus by the nurse during the procedure and while the head is lifted slightly by the accoucher to permit the escape of fluid. If the patient is not having good pains within 15 to 30 minutes pituitrin (obstetrical) 3 minims, is given subcutaneously and repeated every 30 minutes until pains are regular and of 20 seconds or more duration. No serious complications have arisen from this procedure.

Table 10 shows a detailed analysis of the cases of induction.

TABLE 10

Induction labor

Position	Gravida I (cases)	Gravida II + (cases)	Total
O. L. A.	56	55	111
O. R. A.	23	34	57
O. R. P.	4	4	8
O. L. P.	7	7	14
Breech	0	1	1
Total	90	101	191 or 8.3%

EPISIOTOMY—Most episiotomies done were of the median type as recommended by Little of Canada and Titus of this country. When large babies were anticipated the mesolateral type was used and repaired in proper layers. The median episiotomy does not cut any muscles, and it is believed permits of a more physiological episiotomy. Unquestionably the midline incision carries a higher incidence of third-degree lacerations. However, of those occurring in this series, none required secondary repair. Two fistula-in-ano occurred in episiotomy scars and both were in the mesolateral type where no extension of the original incision had occurred. Of the primiparas having a midline episiotomy, none has returned with perineal relaxation, and no reports of any such cases receiving postpartum checks elsewhere have come to this clinic.

Episiotomies were done almost routinely in all primiparas and in those multiparas where there was extreme blanching of the perineum as the head descended.

From table 11 it may be seen that episiotomy was done in 76.1 percent of the primiparas and on 54.1 percent of all cases delivered.

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TABLE 11

Episiotomy

Position	Gravida I (cases)	Gravida II + (cases)	Total
O. L. A	499	161	660
O. R. A	250	83	333
O. R. P	87	30	117
O. L. P	63	16	79
Breech	44	13	57
Total	943 (76.1%)	303 (26.6%)	1,246 (54.1%)

LACERATIONS.—In spite of the high percentage of episiotomies many lacerations occurred. In grading the lacerations the standard classification was used.

It will be seen from table 12 that 2.3 percent of the primiparas and 6.7 percent of the multiparas received first-degree lacerations; 4.7 percent of the primiparas and 6.7 percent of the multiparas received second-degree lacerations; and 2.3 percent of the primiparas and 0.3 percent of the multiparas received third-degree lacerations. The lower incidence of first- and second-degree lacerations in primiparas was due to the high percent of episiotomies done in them as compared to the multiparas. Also, most third-degree lacerations occurred from extension of episiotomies and so its incidence is higher in primiparas. Therefore, 3 percent of the total episiotomies in primiparas resulted in third-degree lacerations, and 1.3 percent of all episiotomies in multiparas resulted in third-degree lacerations. First-degree lacerations occurred in 4.1 percent of the cases; second-degree in 5.8 percent; and third-degree in 1.4 percent. Lacerations, all grades, occurred in 11.9 percent of all cases delivered from below.

TABLE 12

Laceration

Position	First degree	Second degree	Third degree	Total
GRAVIDA I				
O. L. A	17	40	12	69
O. R. A	8	14	7	29
O. L. P	1	2	3	6
O. R. P	2	2	4	8
Breech	0	1	3	4
Total	28 (2.3%)	59 (4.7%)	29 (2.3%)	116
GRAVIDA II+				
O. L. A	45	44	2	91
O. R. A	23	21	0	44
O. L. P	4	2	1	7
O. R. P	4	8	1	14
Breech	1	2	0	3
Total	77 (6.7%)	77 (6.7%)	4 (0.3%)	159
Grand total	105	136	33	275

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COMPLICATIONS ENCOUNTERED.—Under table 13 will be found a list of complications encountered. There were 88 premature births or 3.7 percent. The other leading complication was syphilis which occurred in 35 cases or 1.5 percent of the cases.

Twin births was found in 28 cases or 1.1 percent. This is a ratio of 1:85. Sir Kedarnath Das found twins occurring 1:90 in reviewing 189,185,760 births. Guzzoni quoted by DeLee found twins occurring 1:87 in some 50,000,000 births.

It will be noted that there was a total of 43 preeclamptic toxemias or 1.8 percent. Of these cases, 30 were in primiparas and 13 were in multiparas for a ratio of 2.3:1. This is slightly higher in the multiparas than the studies at the Chicago Lying-In where DeLee found it occurred 3:1 in primiparas as compared to multiparas.

There were a total of five eclamptics in the series. Of these three or 0.12 percent were postpartum eclamptics and two or 0.09 percent were antepartum cases, the total eclamptic incidence being 0.21 percent. None of these were serious and all were controlled by 50 percent solution of magnesium sulfate intramuscularly in 4 to 6 cc. doses and sodium amytal intravenously in from 5 to 7½ grain doses. All were given magnesium sulfate by mouth in large doses and 500 cc. 20 percent glucose in distilled water intravenously once or twice a day. None of the cases had more than five convulsions, and only one had over three.

Monsters occurred in 10 of the cases reaching term or 0.4 percent. This is much lower than the 0.6 percent given by Titus.

The case which went into shock each time she was placed on her back proved quite interesting. No cause could be found to explain the phenomenon. Each time she was allowed to remain on her back for as much as 5 minutes her blood pressure dropped below readings on the baumanometer, she broke into cold, clammy perspiration, became dizzy and confused mentally. No such case could be found in the literature. However, this was not the first case of this type to attract attention. Drs. F. C. Russell and J. W. Ravenscroft had a case at the San Diego County Hospital which was more marked than the case here reported. Both of these patients were completely relieved after delivery.

TABLE 13

Complications encountered

Complication	Gravida I	Gravida II+	Total
Cord about neck	4	1	5
Rigid fibrous cervix	7	5	12
Contracted pelvis	21	10	31
Cesarean	46	29	75
Version	1	2	3
Prolapse cord	4	2	6
Fibroids	3	0	3
Precipitate labor	0	4	4

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Complications encountered—Continued

Complication	Gravida I	Gravida II+	Total
Pyelitis, severe	5	0	5
Nephritic hypertension	1	5	6
Postpartum convulsion	2	1	3
Cleft palate-harelip	2	1	3
G. C. arthritis	1	0	1
Fracture clavicle	1	0	1
Preeclamtic toxemia	30	13	43
Abruptio placentae	0	1	1
P. P. hemorrhage	8	2	10
Premature births	41	47	88
Syphilis	20	15	35
Manual removal placenta	9	8	17
Twins	15	13	28
Tuberculosis	1	3	4
Monsters	5	5	10
Diabetes	1	2	3
Placenta previa	2	12	14
Stillborns	14	13	27
Congestive atelectasis	1	0	1
Epilepsy in mother	1	0	1
Eclampsia	1	1	2
Scabies in mother	1	0	1
Bad tear cervix	3	0	3
Intracranial injury	3	1	4
Hemorrhoidectomy	1	0	1
Severe sapremia	0	1	1
Acne vulgaris	1	0	1
Appendicitis	1	0	1
Paralysis agitans	1	0	1
Cardiac failure	1	3	4
Puerperal psychosis	0	1	1
True Bandl's ring	1	1	2
6 fingers and toes	1	0	1
Eczema in mother	0	1	1
Clubfoot	1	1	2
Pernicious anemia	1	1	2
Duhrssen's incision	1	0	1
Manual dilatation	0	1	1
Varicosity of vulva	0	1	1
Shock on her back	1	0	1

PUERPERAL INFECTIONS.—Puerperal infection has long been a nightmare to the obstetrician. In this series, puerperal infection is very low, but it must be remembered that this does not include infection in cases of abortion as most figures on the subject do. However, the incidence of infection encountered in this series is lower than given by those who have given similar calculations. There were other cases showing morbidity, but no change of lochia, signs of subinvolution, or positive cultures were obtained and so these cases were not classed as infection. There were three cases or 0.12 percent infection in women whose membranes had been ruptured 4, 8, and 10 days before admission. The one whose membranes had ruptured 10 days before was in the hospital some 43 days and ran a most hectic course. In none of these cases was the accoucher notified of the condition until the patient was in labor. There was one case or 0.045 percent following operative delivery and one case in which the cause could not be determined. The total incidence of infection was, therefore, 0.21 percent.

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These cases were treated by small transfusions, large doses of prontosil intramuscularly and general supportive measures. One case was given intrauterine irrigations as recommended by Schwarz of St. Louis.

All cases of infection were moved from the obstetrical floor to another floor so that no nurses handling these cases would come in contact with other obstetrical cases and the doctors used very rigid isolation technic.

POSTPARTUM AND INTRAPARTUM HEMORRHAGE.—The cases here considered were those which lost more than 500 cc. of blood during labor and delivery.

The amount of blood lost today during deliveries is much less than that given by earlier writers. Many writers of today consider over 300 cc. loss of blood a hemorrhage. The authors considered blood losses under 300 cc. as normal; from 300 to 500 cc. an undesirable blood loss; and over 500 cc. a definite hemorrhage.

Approximately 71.5 percent of the cases lost less than 300 cc. of blood. There were 428 or 18.5 percent which lost between 300 and 500 cc. There were 12 or 0.4 percent which had a definite hemorrhage of over 500 cc. Of this latter group 4 lost over 500 cc., 2 lost 600 cc., and 6 lost 700 cc. All but one of those losing as much as 700 cc. had either placenta previa or abruptio placentae. The reason for no greater loss of blood given for the placenta previas and abruptio placentae is due to the fact that the more severe grades of each were cared for by cesarean section and hence are not included in this group.

Morbidity and blood loss of "deliveries from below."—Much has been written regarding morbidity and mortality in obstetrics, especially about the morbidity of cesarean section. This phase will be discussed later. In this series, all cases showing a temperature over 100° on 2 successive days during their stay in the hospital, regardless of cause, were considered morbid. This is more stringent than the most accepted morbidity of 100.2°. On this basis there were 142 cases or 6.1 percent of all the cases showing morbidity. Of this group 62 percent lost more than 300 cc. of blood. Thus, it seems that the morbidity increases markedly with the loss of blood. In other words, of 440 patients losing over 300 cc. of blood, 88 showed morbidity, while only 54 out of 1,863 cases losing under 300 cc. showed morbidity. Therefore, in those losing over 300 cc., 199.75 per 1,000 were morbid, while in those losing less than 300 cc. only 28.98 per 1,000 were morbid.

Under table 14 is listed the blood loss and morbidity according to the various procedures used during the delivery.

It was very interesting to note that of the 17 cases which required manual removal of the placenta not a single case showed any morbidity whatsoever.

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TABLE 14

Morbidity and blood loss

SPONTANEOUS DELIVERY, NO EPISIOTOMY			SPONTANEOUS DELIVERY WITH EPISIOTOMY		
Blood loss	Not Morbid	Morbid	Blood loss	Not Morbid	Morbid
Under 300 cc	481	10	Under 300 cc	394	7
300–500 cc	94	25	300–500 cc	88	37
Over 500 cc	5	0	Over 500 cc	0	0
Not given	86	0	Not given	70	2
LOW FORCEP WITHOUT EPISIOTOMY			LOW FORCEP WITH AN EPISIOTOMY		
Under 300 cc	29	0	Under 300 cc	296	3
300–500 cc	0	2	300–500 cc	78	8
Over 500 cc	0	0	Over 500 cc	3	0
Not given	0	0	Not given	61	1
MIDFORCEP WITHOUT EPISIOTOMY			MIDFORCEP WITH AN EPISIOTOMY		
Under 300 cc	3	0	Under 300 cc	27	6
300–500 cc	0	0	300–500 cc	5	11
Over 500 cc	1	0	Over 500 cc	3	0
Not given	0	0	Not given	0	0
MANUAL ROTAT., MIDFORCEP, EPISIOTOMY			BREECH DELIVERY		
Under 300 cc	67	2	Under 300 cc	90	3
300–500 cc	6	9	300–500 cc	14	0
Over 500 cc	0	0	Over 500 cc	0	0
Not given	0	0	Not given	0	0
DELIVERY WITH 1° AND 2° LACERATIONS			DELIVERY WITH 3° LACERATIONS		
Under 300 cc	203	2	Under 300 cc	21	0
300–500 cc	30	7	300–500 cc	5	7
Over 500 cc	0	0	Over 500 cc	0	0
Not given	0	0	Not given	0	0

ANALYSIS OF CESAREANS.—During the 4-year period there were 75 cesarean sections in a total of 2,378 deliveries or an incidence of 3.11 percent. This is higher than given by many clinics where less than 1 percent cesarean sections are done, but not nearly so high as where approximately 8 percent are done as in one of the leading lying-in hospitals of this country.

There was one cesarean section death in this series. This was the only maternal death of the entire group. The death rate was, therefore, 1.33 percent of the sections. This case died from postoperative ilius with rupture of the transverse colon and peritonitis in spite of Wangeensten suction and other recommended methods of treatment. Autopsy confirmed the diagnosis, and showed that the uterus was well healed and normally involuted at the time of death.

There were three fetal deaths or a death rate of 4 percent which is higher than that of the entire series. However, it must be recalled

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that many cases had sections for severe placenta previa, etc., where the baby was in very poor condition at the time of the operation.

The ages of the patients ranged from 18 to 42 years with an average of 27.23 years. There were 45 primiparas and 30 multiparas. One para IV had a section because of breech presentation and a huge ventral hernia in the mother; another para V had a section for severe hemorrhage due to placenta previa and no labor. The other multiparas were largely para I and II.

The morbidity, according to the standard previously given, was 53.3 percent or 40 cases for all sections done. Of the 75 cases done, 37 were elective cesarean sections in which there was no labor, and of these 21.6 percent showed morbidity. Three of these had bronchitis or breast infection or both. Of 38 given a test of labor, 31 or 86.8 percent showed morbidity. In most of the cases the morbidity was of no great concern as the patients felt well and showed no other signs of infection. There were only 3 which caused concern. The majority of them were free of fever by the fifth or sixth day at most, and it is noted that the average for hospital days was 10.7 while all cases but 1 were required to stay 10 days. This 1 case remained 9 days, and 9 stayed over 10 days. The longest was 36 days.

Thirty-eight cases were given a test of labor averaging 29 hours; the shortest 6 hours and the longest 60 hours. All cases having less than 4 hours labor were classed as elective sections. There were 37 in this latter group.

The position of the fetus at the time of the sections were as follows: O. L. A. 16 or 21.3 percent; O. L. P. 14 or 18.6 percent; O. R. A. 5 or 6.6 percent; O. R. P. 25 or 33.3 percent; transverse 7 or 9.3 percent; breech 8 or 10.6 percent. This showed normal position (O. L. A. or O. R. A.) in only 21 or 28 percent of the cases.

The average weight gain during pregnancy was 25.4 pounds with a variation from 10 to 48 pounds.

Since compiling these figures one case of endometriosis in the incision has occurred. The patient was operated and made an uneventful recovery.

FETAL MORTALITY.—The fetal mortality described here included only those babies dying during the first 10 days after delivery or being still-born, plus any premature babies which died before being allowed to go home no matter the length of the stay in the hospital. There were 60 such deaths for a mortality of 2.52 percent in the entire series.

There were 32 deaths in babies born between 5 and 7 months of gestation. This accounted for 53.3 percent of the deaths. These figures indicate that 1.3 percent of all births will die because of premature birth. The intracranial injuries were 7 in number for 11.6

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percent of the deaths. Thus, 0.2 percent of all the babies delivered died from intracranial injury. There were 10 monsters, all born dead, which accounted for 10 percent of the deaths. The incidence of monsters was 0.42 percent in this series.

The still-born babies were grouped as follows: as to cause, number and percentage of total deaths.

(1) Prolapse cord, knots in cord, or cord about the neck, six cases, or 10 percent.

(2) Placenta previa, one case, or 1.6 percent.

(3) Toxemia in the mother, three cases, or 5 percent.

(4) Cause not listed, two cases, or 3.3 percent.

There were two cases of congenital atelectasis, which died soon after birth, accounting for 3.3 percent of the deaths. There was one death listed as due to breech delivery, or 1.6 percent of the deaths. There were no cases of fetal death occurring between 7 and 9 months' gestation having premature birth given as the primary cause of death.

TIME OF DAY BIRTHS OCCURRED.—Table 15 gives the number of births occurring each hour of the day for the entire series. From 0600 to 1800 (6 a. m. to 6 p. m.) there were 1,220 births, or 51.1 percent. Hence, it may be seen that the time-honored idea that all babies are born at night is disproven. It appears that the woman in labor is just as likely to have the baby during the day as she is during the night.

TABLE 15

Time babies were born

Time	Number	Time	Number	Time	Number
0000 to 0100	87	0800 to 0900	124	1600 to 1700	113
0100 to 0200	82	0900 to 1000	126	1700 to 1800	111
0200 to 0300	87	1000 to 1100	90	1800 to 1900	95
0300 to 0400	98	1100 to 1200	83	1900 to 2000	129
0400 to 0500	99	1200 to 1300	74	2000 to 2100	104
0500 to 0600	88	1300 to 1400	101	2100 to 2200	102
0600 to 0700	101	1400 to 1500	81	2200 to 2300	87
0700 to 0800	106	1500 to 1600	110	2300 to 2400	100

WEIGHT OF THE BABIES.—Table 16 gives a summary of the weight of the babies. The most accepted normal birth weight is 7 to 7½ pounds (3,200 to 3,400 gms.). It can be seen that there were 891 babies, or 37.5 percent of all the babies, weighing under 7 pounds, but only 258 or 10.8 percent, weighed under 6 pounds. Only those babies which weighed under 6 pounds were classed as premature infants and cared for as such in the nursery. All babies were kept in the nursery until a weight of 6 pounds was attained before they were allowed to go home to the mothers.

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TABLE 16

Weight of the babies

Weight (pounds)	Gravida I (number)	Gravida II+ (number)	Total (number)
2 to 3	12	13	25
3 to 4	11	15	26
4 to 5	28	25	53
5 to 6	85	69	154
6 to 7	380	253	633
7 to 8	456	453	909
8 to 9	213	230	443
9 to 10	45	70	115
10 to 11	7	10	17
11 to 12	0	1	1
Total	1,239	1,139	2,378

SUMMARY

(1) The growth of the naval maternal and pediatric clinic at the Mercy Hospital, San Diego, Calif., is presented.

(2) An analysis of 2,378 births, including 75 cesarean sections is given in detail.

(3) Normal and operative deliveries, including forceps, episiotomies, and lacerations are compared.

(4) Complications encountered, including eclampsia, toxemia, hemorrhage, infections, etc., are discussed.

(5) The various types of sedation, anesthesia, and analgesia are enumerated.

(6) Fetal mortality, maternal mortality, and morbidity are listed.

(7) The time of day babies were born, their weights, as well as the sex incidence are considered.

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HOSPITALIZATION OF NAVAL DEPENDENTS [1]

By Commander J. R. White, Medical Corps, United States Navy

The Marine Barracks at Quantico, Va., was first established in May 1917 as a Marine Corps camp of instruction. The camp was located in a swampy area, adjacent to the small town of Quantico, which in the Indian language means "sticky mud." The locality was heavily infested with malaria. Sanitation problems incident to the concentration of men under these conditions taxed the ingenuity of medical officers to the utmost. Personnel were either sheltered under canvas or housed in temporary wooden buildings. Influenza and meningitis took a heavy toll, but, owing to excellent work on the part of the medical department, the records show a remarkably low incidence of malaria. From this dismal beginning the barracks has developed into a modern military post with a population of over 5,000. Recreation facilities include golf, tennis, swimming, movies, polo, and sailing. Excellent schools provide educational facilities through the eleventh grade, and an up-to-date officers' club provides facilities for banquets, dances, and other entertainment. Dramatic and garden clubs are popular. In the quarters section paved roads wind among beautiful homes and modern apartments. Barracks of the latest type are provided for enlisted personnel.

As the post developed it became imperative that some provision be made for the hospitalization of dependents, and in 1922 the family hospital was established. This institution was unique in that it was the first of its kind in the naval service. Similar institutions patterned after this hospital have since been organized at other naval activities.

In its early days the institution was very small, consisting of only six rooms. Patients were subsisted from sick quarters mess. Funds for the payment of civilian nurses and other expenses were procured by means of voluntary donations, benefit entertainments, and small charges for hospitalization. This haphazard procedure was not satisfactory, and an association of married officers and men was formed, with monthly dues and fixed charges for hospitalization.

The association has prospered. The present membership is over 600 officers and men whose dependents are entitled to naval medical attention. The management of the association is under the direction of a council consisting of a president (the post surgeon), the medical

[1] As effected at the Marine Barracks, Quantico, Va.

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officer in charge of the family hospital, and three other members appointed by the commanding general. The administration, maintenance, and operation of the hospital is under the direct supervision of the post surgeon or his representative.

The hospital in its present form consists of 12 beds for general service and an isolation unit of 8 beds. There is a well-equipped delivery room and nursery. Surgical procedures other than deliveries are performed in sick quarters operating rooms, and all laboratory work is done at sick quarters. Personnel includes a chief nurse as supervisor, 3 graduate nurses, a cook, and 2 maids. The nurses and cook live on the premises. The officer in charge of sick quarters is in immediate charge of professional service which is divided as follows: Medical, in charge of the family physician; surgical, in charge of the operating surgeon at sick quarters; E. E. N. and T., in charge of the specialist at sick quarters; and obstetrical, in charge of a medical officer trained in this work. By this division of professional service, patients have the advantage of specialized service and medical officers benefit from the opportunities afforded by group practice.

During the calendar year of 1938 there were 365 admissions with a total of 2,659 sick days. Of these 18 were major surgical cases, 87 were obstetrical conditions with 64 deliveries; 66 were tonsil and adenoid operations, and the others, acutely ill women and children. Patients suffering from mental or chronic conditions are admitted only temporarily to the hospital.

The finances of the hospital are in good condition, and a substantial reserve fund is being built up. Monthly dues and daily charges are as follows:

Rank or title	Monthly dues	Daily charges	Rank or title	Monthly dues	Daily charges
General officers	$2.50	$2.00	Warrant officers	$1.00	$1.50
Colonels	2.00	2.00	Enlisted men, by pay grade:		
Lieutenant colonels	2.00	2.00	First	1.00	1.00
Majors	2.00	2.00	Second and Third	.75	1.00
Captains	1.50	2.00	Fourth to Seventh	.50	.40
First lieutenants	1.00	2.00	All others	.75	1.00
Second lieutenants	1.00	1.50			

Similar ranks of the Navy have corresponding charges as those listed above.

An additional charge of $5 is made for each obstetrical case and for major operations. For minor operations, such as tonsillectomy, the charge is $2.50. For special nurse a charge of $1 per day is made to cover board.

In case any member of a family of an officer or enlisted man eligible for membership in the association, but not a member, is admitted to the family hospital as a patient, the hospital charge for said patient is

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$10 a day for the period of hospitalization, plus $25 for the use of the operating room when required.

The financial affairs of the association are handled by a bonded secretary-treasurer who renders monthly bills, collects all moneys, and pays all outstanding bills.

The double entry bookkeeping system is used to record transactions of the association. Receipts in excess of expenditures are deposited to the credit of the association, in a savings account, $2,000 of which is held as an emergency reserve, and the balance designated as a building fund. The principal expenditures consist of salaries as follows:

	Per month
Chief nurse	$100
Nurses (3) at $90	270
Cook	50
Maids (2) at $35	70
Secretary-treasurer	70

In addition to the above there are expenditures for special medicines, medical supplies, commissary supplies, and laundry. The cost of ration averages about 60 cents per day.

The family hospital has served this post for nearly 17 years and has borne out the confidence and foresight of its originators. It has never failed in its mission of affording adequate hospitalization to its members at reasonable rates. It is believed that the application of this system to other stations, where naval hospitals are not available, would solve the difficult problem of hospitalization of dependents.

SOCIAL SERVICE FOR NAVAL DEPENDENTS

By Capt. Lucius W. Johnson, Medical Corps, United States Navy

Goodwill as an asset of value to a military outfit is such a modern conception that its possibilities are not yet generally appreciated. With a democratic form of government, where men for the military forces are recruited by voluntary enlistment, and the money to support their activities is voted by representatives elected by the people, the matter of goodwill and public regard may become a very important one. We would all be benefited if the public were educated to regard the Navy not as just a costly form of insurance against war, but also as a training school for young male citizens, as a source of help in the disasters of peacetime, and as a beneficent organization which endeavors to lend a friendly hand to those whose service careers are terminated by illness or injury.

In recent years it has been realized in our military services that adjustment of the social and economic problems of the service man and his family improve his morale, keep him out of trouble, and greatly increase his usefulness to the organization.

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Navy men—believe it or not—are quite human in their activities and their domestic relations. They marry, they have children, they have mothers-in-law, they have sickness in their families, even as you and I. Any of these may lead to complications which a man on a ship at sea, or sick in a hospital, is unable to cope with unless he has some outside help.

Take babies, for instance. They are not always considerate. Sometimes they come at the wrong time. Sometimes they come to those who cannot afford them. Then, too, they demand milk, and a lot of care. If a baby comes to a sailor's wife who has a job, it may precipitate a financial crisis in that family. If the wife be sick and unable to care for the baby, while the sailor is at sea, or sick in the hospital, help is needed again.

Sailors are also like other people in that a certain number of them do not provide adequately for their families; some even abandon them, and a few neglect to pay their bills. All of these lapses lead to financial and legal problems which are dumped in the lap of the executive officer who passes them right on to the Red Cross social workers, and ceases to worry about them because he knows they will be taken care of by competent experts.

All mass activities, including the Army and Navy, must be founded on morale. Without it, they quickly disintegrate. Worry plays havoc with morale, and lowered morale means rapid loss of efficiency. The success of a military action may be endangered by impairment of the morale of a few of its men. So it is recognized as being of definite military value to assure the service man that his physical disabilities will receive the best of professional care, and that his loved ones at home will be aided when they are in difficulties. Thus the doctor and the social worker combine to form an indispensable team.

SERVICE RENDERED FAMILIES OF PATIENTS

Among the numerous letters which come daily to the desk of the executive officer there are sure to be several from anxious mothers, wives, or other relatives of some of our patients. Perhaps a boy has written his mother that he is about to go to the hospital, and then has failed to write to her again for several weeks. Boys sometimes do things like that. The frantic mother writes to find out what is wrong and how serious it may be. Perhaps a man is injured in an accident, and it is broadcast through the press that he has been sent to the naval hospital. Immediately, his friends and relatives write to request the details.

Such letters are turned over to the Red Cross medical social worker. She visits the patient, talks with the doctor in charge of the case, and then writes a letter to the anxious one, giving whatever details are suitable. These letters are composed in such an understanding and

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reassuring form that they must bring great solace to those who receive them. Every time these letters are brought to me, to be read and approved, I think how fortunate the Navy and the relative and the patient are to have such an interpreter to act for them.

Should it be advisable for the parents to come to visit a patient whose condition is serious, it is the Red Cross representative who, through the home chapter, helps to arrange and finance the trip, if that be necessary. Should they be old, feeble, or unaccustomed to the complexities of the big city, we call upon the Red Cross once more to meet them at the train, find a place for them to live, and smooth out a hundred rough spots for them.

In many of our minor daily problems we call upon the Red Cross to aid us—for instance—

Let us suppose that Charlie Noble, seaman, United States Navy, receives a telegram, "Father very sick; you are urgently needed; come home at once." He brings the telegram to the executive officer with a request for 2 weeks of leave. Now the executive is in a hot spot. He knows from experience that 70 percent of such telegrams are "bloomers," being sent at Charlie's request, because he is homesick and wants to come back to see his girl, and to taste some of mother's home-made apple pies.

But the 30 percent of bona fide telegrams cannot be ignored, and the executive does not want to refuse leave if the cause is justified. So what does he do in such a dilemma? He asks the Red Cross to investigate. They get in touch with the chapter in Charlie Noble's home town. Some one from that chapter visits the Noble home, offers aid if it be needed, and sends back the information required to complete the picture. So the decision concerning leave for Charlie Noble is made on the basis of reliable information instead of on a mere hunch.

Should Charlie Noble be urgently needed at home, and have no money to get there, the Red Cross hospital worker and the home chapter arrange a loan, so that he may go at once, and repay the loan by monthly allotment. Much comfort is afforded to bereaved families in this way.

Naval hospitals have another problem which is more pressing than in civilian hospitals. In the latter, most patients leave as soon as the dangerous stage is over, and return to their homes to complete convalescence, thus reducing the expense of hospitalization. But in the Navy, their home is on board ship and there, space is so restricted that there is no room for a convalescent man to loaf without getting in the way. So patients are retained in naval hospitals until they are in all respects able to perform their duties at sea.

This entails a much longer stay in the naval hospital and, in many cases, a considerable stay after the patient is able to be up and about.

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During this period, boys are liable to be full of steam and mischief, and to get into all sorts of trouble if they are not kept busy and amused. We are indebted to the Red Cross for extensive recreational activities, which supplement those which the Navy is able to offer.

The modern practice of medicine in large hospitals no longer allows much opportunity for intimate acquaintance between doctor and patient, no matter how valuable such a relation would be. Many years ago it was written that it is often more important for the doctor to know what kind of patient has the disease than what disease the patient has. To determine what sort of a patient we have, we must know something of his family and social background.

SERVICE TO THE MENTALLY ILL

Especially in the case of a patient who is suspected of having a mental condition, it is necessary to acquire as complete a perspective of his background as we can. Very often an acute mental disability may be precipitated by worry, homesickness, or a failure to adjust to a new environment which appears intolerable. Treatment of such a case is always simplified if the doctor can learn all about the boyhood, home life, and general activities of the patient. But securing such information is a highly specialized activity for which the physician has no time and very often no aptitude.

For such needs the social worker is a very valuable member of the medical team who is trained for this duty and seldom disappoints us. Let me recite a case which we had at the San Diego Naval Hospital, to illustrate this point. A sailor was riding with his girl on a motorcycle. They had a collision, in which both were seriously injured. The sailor was brought to the naval hospital and the girl was taken to another hospital in the city. The boy did very well so far as his physical injuries were concerned, but he soon developed an acute anxiety neurosis.

The doctor in charge of the case suspected that worry over the girl and his responsibility for her injury was a factor in the case, so he requested the Red Cross social workers to look into it. They did so, and soon were able to report to the boy that the girl was being properly cared for and that arrangements had been made for taking care of her hospital bills. They induced the girl's mother to visit the boy to assure him that all was going well with her daughter, and that there was no resentment against him on the part of the family. This alleviated the boy's anxiety and he soon was once more on the road to recovery.

Another burden borne by the Red Cross is checking the treatment of syphilitics in the out-patient department of the hospital. Their workers keep the record of treatments received and notify those who fail to come for their injections. When the patients continue to be

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delinquent in this respect, they are reported to the city health department, which has the necessary police powers to compel them to continue treatment until they are no longer a menace to the community.

There is a rule of nature that concentration of living organisms in a limited space means death to many of them. To defeat this law, and to maintain men in perfect health in the concentration which is necessary on a warship, requires strict regulation of hygiene and of conduct. Only by conforming to elaborate rules is it possible for large numbers of men to live and work in such confined spaces as in a submarine, for instance.

But many persons are temperamentally so constituted that they cannot or will not submit to such close regimentation. A certain number of our recruits are of this type and they find it difficult to conform to the necessary discipline. Some manifest this inability by various forms of misconduct, others by mental or physical break-down.

In such cases we ask the Red Cross social workers to establish friendly and understanding relations with the families; to study the family backgrounds and the boyhood histories of the patients; to secure the cooperation of the families in the treatment and disposition of the patients; and finally, to continue to help the men and the families after they are returned to their homes.

Contrast this arrangement with the custom of earlier days, when the discharged service men were simply given transportation to their homes and allowed to make their own adjustments without any organized aid. You will then realize how much the work of the Red Cross aids in stabilizing both the man and the community.

When a man is discharged from the service, whether handicapped or not, he often requires assistance in securing Government benefits, to which he is entitled by law, and in planning his future. The Red Cross social worker aids him in preparing his application for pension, helps him to secure vocational training, looks into his family problems and, by putting him in touch with the chapter in the locality where he is to go, helps to fit him into his new niche with the minimum of friction.

This matter of the reestablishment of the man in the community is a vital one both to the community and to the man. The local chapter endeavors to find employment for the man and to see that the family receives whatever aid be necessary during the period of adjustment.

The evil effect of worry on the outcome of sickness is well known, and it is an influence from which our naval hospitals are not exempt. The service man's food, clothing, housing, and hospitalization are well looked after by the Government, but often there are serious domestic difficulties which prey on his mind and prolong his convalescence. It is of very great value to be able to say to such a patient, "Don't worry any more, son. The Red Cross will take care of that." Then follows

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an interview with the social worker, who finds the cause of the worry and usually is able to arrange a solution of the problem.

A sick man has few mental diversions and, if he has domestic problems, he is liable to devote the whole 24 hours to ceaseless anxiety about them. It lifts a great load from his mind if he knows that the sick wife at home will be cared for; that the babies will be fed; or that the family will not lose the roof that shelters them while he lies helpless in bed. That is a powerful aid in his recovery.

Some critic has remarked that, if these activities are so essential to the Navy, then the Navy should provide its own organization to handle directly the cases now taken care of by the Red Cross. A little examination shows many fallacies in this line of reasoning. In the first place, it would take many years to build up a satisfactory organization, and to assemble the personnel to carry on the work. It would be impossible to reproduce a chain of communications such as the Red Cross has, which reaches every cross-roads and hamlet in the whole country through its 3,712 chapters and 8,331 branches. Also, years of experience have led to the conclusion that certain social difficulties of service men are best studied and treated by nonmilitary personnel. This work is being done at present in a most praiseworthy manner by Red Cross personnel who, because of the nature of their organization, have an understanding of military conditions and requirements, combined with training in the technique of the social sciences.

I could relate a number of amusing and annoying episodes to illustrate the harm done and the resentment aroused by injudicious but well-meaning persons who visit our hospitals. They are good people, with the best of intentions, frequently full of unintelligent sympathy and emotion. Their efforts form a striking contrast to those of the professional social workers provided by the American Red Cross, who have a high standard of excellence to which they must conform. We owe a great debt of gratitude to them.

THE CYSTIC OVARY

By Lt. Carl V. Green, Jr., Medical Corps, United States Navy

It is the purpose of this paper to invite attention to a condition which not infrequently obtains in women, during the period of sexual activity, characterized by cystic changes in the ovary, and by an associated, rather characteristic clinical picture. This, at times, may be of a degree of severity that may be thought to call for surgical treatment; but, altogether too often, is this procedure doomed to failure, inasmuch as the mechanism behind the production of these changes in the ovary will still continue and maintain should any tissue be spared during the course of any operative work.

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These cystic ovaries, in the great majority of cases, develop upon the basis of a pituitary deficiency: A qualitative, or a quantitative, affair with reference to the prolans. These follicular cysts have been ascribed to an overacting pituitary; but the probabilities are that they result from an imbalance between the follicle stimulating fraction, prolan A, and the luteinizing fraction, prolan B; there being, in most instances, a lack of the latter. With this condition, which has been termed "follicle cystosis" by some workers, there is usually the picture of menorrhagia, due, in turn, to the hyperplastic endometrium which attends such follicular abundance. The degree of hyperplasia does not, however, determine the amount of bleeding. Novak [1] has even found it in association with amenorrhea. King [2] has examined the ovaries in cases wherein marked menorrhagia had been noted. He speaks of the "uncontrolled" follicles, and of the absence of normal corpus lutein structures. He subscribes to the fact, that upon theoretical grounds, the treatment of this condition with the luteinizing fraction of the pituitary is indicated, but states that clinically, the results obtained with the use of this product (progestin) have been far from satisfactory. Were the cystic changes in the ovary, with their attendant endometrial consequence due entirely to an excess of the follicle stimulating fraction, one might expect aggravation of the picture by treatment with the anterior pituitary-like substance (antuitrin S). This, however, does not occur; and it is likely that a definite stabilizing effect upon the normal cyclic phenomena of the ovary obtains. Under this type of treatment, a probable result is the luteinizing of the persistent follicles. This has been pointed out by Witherspoon and Collins.[3] That the functional span of the corpora is prolonged by administration of extracts of the anterior lobe, has been demonstrated by the experimental work of Shelesnyck,[4] and by Smith and White.[5]

Needless to say, hormonal dysfunction is invariably a pluriglandular affair, and when the pituitary, which is recognized as the master gland gives evidence of either hypofunction or hyperfunction, there results considerable disturbance with reference to the function of the other members of the endocrine system. In this series of cases definite evidence of this involvement was noted. It was demonstrated by the defect in ovarian control, which involves the prolans and by degrees of thyroid dysfunction, probably effecting through the thyrotropic fraction of the pituitary. Involvement of the adrenals was noted, and here, a possible defect with reference to the adrenotropic hormone obtained.

[1] Novak: Curtis' Obstetrics and Gynecology, vol. III, ch. 69, W. B. Saunders.
[2] King, J. E.: Am. J. Obst. and Gynec., 26: 582-587, 1933.
[3] Witherspoon and Collins: New Orleans Jour. Med. and Surg., 88: 205, 1933.
[4] Shelesnyak, M. C.: Am. J. Physiol. 98: 387-393, 1931.
[5] Smith, P. E., White, W. E.: J. A. M. A., 97: 1861-63. 1931.

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It is a frequent observation, that with a primary pituitary deficiency, there is obtained evidence of overactivity of some other, or others in the endocrine group. For example, there may be hypopituitarism associated with hyperthyroidism, hypopituitarism associated with hypothyroidism combined with some degree of hyperovarianism, or hyperadrenalism. In my experience, treatment aimed at the restoration of normal pituitary function has resulted in improvement in a very high percentage of such cases of pluriglandular involvement.

Thirty-six cases of ovarian dysfunction were studied, and a diagnosis of an underlying pituitary deficiency was made in each after a thorough workup, which took into consideration: The history, physical findings, anthropometric measurements, basal metabolism studies, and blood chemistry determinations. There were some very interesting minor findings which came to light during the course of study of this group, and these will be given below.

The symptoms which attend this condition vary within certain limits. Invariably there was ovarian pain, which was frequently referred to the back and thigh region. This was usually of greatest severity about the time of the menstrual period. A vaginal discharge, frequently chocolate colored, both preceded and followed the menstrual period in many instances. Menorrhagia was the rule, and was of greatest severity in those cases associated with hypothyroidism. Seven cases demonstrated hypomenorrhea, and here, some degree of hyperadrenalism was noted, as well as a low sugar tolerance. The problem of sterility frequently presents itself in this type of case. Other cases, wherein some measure of hypomenorrhea was met with, gave evidence of slight hyperthyroidism; and here dysmenorrhea seemed most marked. Brahm, quoted by Curtis [6] has also noted this. Breast pain, and frequently inadequate breast development, are observed in cases of this type of endocrinopathy. This finding, seemingly lends further support to the rationale of theelin (the follicular hormone) in the treatment of the condition termed mastopathia, or mazoplasia.

Symptoms which probably have as their point of origin, the underlying deficient pituitary gland are:

(1) HYPOTENSION.—Probably effecting thru the adrenals; associated with this were cold extremities, and occasionally, a mottling of the skin over these was noted.

(2) EPISTAXSIS.—A very interesting, and possibly very important fact with reference to the diagnosis of pituitary deficiency, is the presence or history of this finding. It was noted in over 60 percent of the cases in this group, and in nine cases presenting a frank growth deficiency. In children, the same was noted. Two of these demonstrated Frohlich's syndrome. Alterations in capillary tone might explain the mechanism of nosebleed in cases of pituitary dysfunction.

(3) SWELLING of the hands and feet.—the majority of cases in this group complained of transitory swelling of the hands and feet. This, while not obvious, was

[6] Brahm: Curtis' Obstetrics and Gynecology, vol. III, W. B. Saunders.

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definitely noticeable to the patients. It was often of greatest degree upon arising. This phenomena might be explained upon a basis of water retention that of necessity attends an elevation in the chloride content of the blood that is met with in pituitary hypofunction.

(4) HEADACHE.—This was met with in all cases in this group. It was essentially migrainous in type, and usually menstrual in periodicity. These certainly may be designated as "pituitary" headaches, and ascribable to increased tension within the gland. The successful treatment of this type of headache with pituitary medication has been reported.

(5) GRINDING of the teeth.—Four cases in this group complained of an uncontrollable "grinding" of the teeth that was experienced at times. The explanation of this had best be left to the neurologist

(6) ENURESIS.—Nine cases in this series gave a history of this condition in childhood.

Tenderness and some enlargement of the ovarian structure were noted in all cases in this series. In some cases the ovary was found to be the size of a lemon, and at times, the prolapse of these enlarged organs behind the uterus gave rise to dyspareunia. Invariably, hypoplastic or actual infantile development of the genitilia was found. Only five cases had borne children, and in every instance there had been a prolonged and difficult labor. Nine patients had been given a previous diagnosis of ovarian cyst, and in addition to this number, seven had undergone previous surgery for this condition. These stated, when first seen, that their complaints were essentially the same as they were at the time they submitted to such surgical treatment. There was only this difference, their pain and distress were on the side of the remaining ovary. Thus, one may gather that surgery for these functional cysts of the ovary may be likened to the procedure of dilatation and curettage for the menorrhagia and metrorrhagia which attend follicular hyperplasia, developing upon the basis of an underlying pituitary dysfunction, and with resultant ovarian dysfunction. In either event, we are treating the end result only.

The measures which served to bring to light the underlying hypofunction of the pituitary gland in this collected group of cases were:

(1) ANTHROPOMETRIC MEASUREMENTS.—Lower extremity of greater dimension than the upper extremity; span greater than height. This finding has been described in association with the condition of hypoovarianism; but it would appear that it definitely relates back to a pituitary deficit, and is merely a gonadal manifestation of the same.

(2) RETARDED GENITAL DEVELOPMENT.—As stated previously, infantile, or at least hypoplasia of these organs were found.

(3) DENTAL DEFECTS.—These varied from the prominent central incisor teeth to the absolute absence of certain molars. A few patients in this group had a relative underdevelopment of the lower jaw as well.

(4) BASAL METABOLIC RATES.—These were frequently low despite absence of signs of thyroid deficiency, and with a normal figure for blood cholesterol. The question of water retention within the tissues enters into the explanation of this

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finding, and it is to be recalled that rates as low as minus 40 are reported in Simmond's disease—Wolf.[7]

(5) BLOOD CHEMISTRY.—(*a*) *Chlorides.*—Some elevation of the chloride content of the blood was noted in the majority of cases.

(*b*) *Sugar.*—An elevated tolerance was the rule, save in those cases that gave evidence of some over-activity of the adrenals. In hypopituitarism, this increased tolerance may be marked; and this factor may account for the ready fatigue experienced by most of these patients.

(*c*) *Cholesterol.*—This determination served, in the main, to identify any coexisting degree of thyroid dysfunction. Hypofunction of this gland seemed to be associated with the pituitary deficit in the majority of the reported cases.

It would appear, after considering all of the evidence, that we may justly incriminate the pituitary gland. There apparently exists a qualitative or a quantitative deficiency. Further proof of this is at hand when we evaluate the results of treatment aimed to combat such deficiency. Such was provided by administration of the anterior pituitary-like substance commercially available as antuitrin S, and desicated thyroid substance when indicated. The latter was given in minimal amounts even in those cases with an apparently normal functioning thyroid gland. Some workers believe that the action of the pituitary medication is enhanced by such administration. Drouet[8] believes that hyperthyroidism may be due to a degree of hyperfunction of the pituitary gland. Likewise, the frequent association of some degree of hypothyroidism noted in this group of pituitary deficient patients may be explained upon a basis of the thyrotropic fraction want.

Under treatment with the aforementioned preparations there was improvement in all cases. Relief from the distressing menorrhagia was striking and constant. It is only to be observed that the dosage must be adequate. Fluhmann,[9] Macfarlane,[10] Klingler and Burch[11] have all reported upon the efficacy of the anterior pituitary-like substance in this condition.

The great majority of cases experienced marked relief from menstrual pain. Some relief was obtained from the ovarian pain in all cases, and it disappeared entirely in more than half of the cases in the group. There was found to be a definite regression insofar as the size of the ovarian structure was concerned in most cases. In one instance, complete disappearance of a cystic structure the size of a lemon was noted after treatment over a period of time. This finding was confirmed by an inspection of the ovary at the time of an emergency appendectomy. It seems very probable that this restoration to normalcy of the organ follows the restoration of normal ovarian control which is afforded by this type of substitution therapy.

[7] Wolf, W.: Endocrinology in Modern Practice. W. B. Saunders Co.
[8] Drouet, P. L.: Rev. franç. d'endocrinal. **12**: 101-136, 1934.
[9] Fluhmann, C. F.: Ann. Int. Med. **6**: 1212-1224, 1933.
[10] Macfarlane, C.: Penn. Med. J., **40**: 254-257, 1937.
[11] Klingler, H. H., and Burch, J. C.: Amer. J. Obst. and Gynec., **26**: 17-21, 1933.

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Headache ceased to be a complaint under treatment. Even after the menopause, the same type of headache is met with and I have found that as little as 1 cc. of antuitrin S will keep these individuals free from the same for a considerable period.

The vasomotor symptoms were relieved by treatment. Whereas some degree of hypotension had frequently complicated the picture before, there was the restoration of the blood pressure to an accepted normal. There was no further awareness of swelling of the hands and feet, once treatment was underway. There were no more episodes of epistaxsis incident to treatment. Many patients in this group had been troubled with constipation prior to treatment. Possibly the increased tone of smooth muscle that results from pituitary medication will explain the relief of this condition experienced by most of the patients following treatment. One must bear in mind that the preparations available for clinical use are, by no means, pure substances. It seems probable that certain active principles of the pars intermedia of the gland are present in variable amounts including certain functions related to pressor effects and water metabolism.

In the cases that had demonstrated some degree of overactivity of the adrenals, with a resultant low-sugar tolerance, it was found that after treatment for a time that there was a flattening of the sugar curve. In one of such cases, pregnancy resulted. The problem of sterility has been discussed by various workers with reference to the diabetic woman and some rather interesting speculations may be made with reference to the abnormal sugar level of the blood being, in itself, a factor in these cases of infertility.

It would appear that surgical methods do not constitute the treatment of choice for these so-called functional cysts of the ovary, both from a consideration of the history and findings in the case of the seven in this series that had had previous operative treatment for the ovarian condition, and from an analysis of the findings reported by Stabler.[12] He reports 93 cases that were operated upon because their symptoms seemed to relate directly to the ovary, both preoperatively and postoperatively. Follicular, lutein, and retention cysts were the rule. His treatment was resection of the ovary if as much as one-sixth of the gland could be spared, and complete removal if the patient was over 36 years of age. About 50 percent of the cases obtained relief from pain, and the remainder were not relieved, and here it was thought to be due to the remaining ovarian tissue. No uniform improvement with reference to menstrual complaints was noted. It seems logical to reason that any remaining ovarian tissue

[12] Stabler, E. V.: J. M. A. Alabama, 7: 150–155, 1937.

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is equally as vulnerable to those changes which may result from pituitary dysfunction as is the intact gland.

In conclusion, may I emphasize the fact that changes in the ovary, usually characterized by cyst formation, frequently are a manifestation of a definite pituitary dysfunction, and that there is often a resultant alteration manifest with reference to the menstrual cycle. The follicle cystosis which obtains results in an enlargement of the ovarian structure and rather typical ovarian pain ensues, and constitutes a rather common symptom of this condition. Menorrhagia most frequently is met with and reflects the endometrial changes incident to the presence of these "uncontrolled" follicles. Investigation of the endocrine status of patients presenting the above picture will very often throw light upon the situation. Correction of deficiencies found will, in a high percentage of cases, rectify all menstrual abnormalities and bring about a restoration to normal of a semi-pathological ovary.

SUMMARY

Thirty-six cases of ovarian dysfunction were studied, and a diagnosis of underlying pituitary deficiency was made in each. Cystic changes in the ovary were the rule and there was rather typical ovarian pain in all of the cases studied.

Menstrual disturbances were noted in connection with the above, usually including menorrhagia and dysmenorrhea. Hypomenorrhea, associated with the same cystic changes, was noted when there was some degree of associated hyperthyroidism, or hyperadrenalism.

Symptoms noted that probably relate to the primary pituitary dysfunction were: Hypotension, epistasis, transitory swelling of the hands and feet, and migrainous headache.

Anthopometric measurements and the finding of genital underdevelopment gave weighty evidence to the diagnosis of this pituitary dysfunction. Blood chemistry and basal metabolic rate determinations further substantiated such diagnosis.

Under appropriate and adequate treatment, substitutive in nature, marked relief of the subjective symptoms was obtained. In many instances it was apparent that regression of the abnormal ovarian structure resulted.

It would appear that substitution therapy offers much with reference to the relief of many untoward symptoms that accompany these so-called functional cysts of the ovary; and that the recognition of certain cystic ovaries as functional affairs will spare many patients from surgical measures, which, at best seem to offer relief in about 50 percent of cases.

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DERMOID CYST OF THE OVARY[1]

WITH CASE REPORTS

By Comdr. L. L. Edmisten, Medical Corps, United States Navy

The increasing amount of medical care afforded dependents of naval personnel has produced new diagnostic problems for both the medical officers assigned to out-patient duty, and to those officers concerned with clinical pathology and roentgenography. Two case reports illustrative of such problems are presented. In each instance the interpretation of x-ray films of the abdomen provided the diagnosis which was subsequently confirmed at operation and by examination of the tumor removed.

CASE REPORTS

Case 1.—B. H., a primipara, 22 years of age, entered the out-patient clinic complaining of a painless tumor in the left side which had been present for about 6 weeks and was slowly increasing in size. Aside from smallpox at 3 years of age, patient's past history was not significant and she had had no injuries, operations, or other serious illness. Her menses had been regular and not troublesome, bowels were regular and she had never had a venereal disease. She was first observed during the second month of pregnancy.

PHYSICAL EXAMINATION revealed no abnormalities aside from a palpable mass to the left of the umbilicus which was freely movable, and did not seem to be attached to any viscus. Anterio-posterior stereoscopic films and a left lateral film of the abdomen demonstrated an elongated spheroidal shaped tumor, with a pedicle arising in the location of the left ovary. Areas of calcium deposit were noted in the fundus of the tumor, and one molar and one cuspid tooth were identified in the cyst wall. A roentgenological diagnosis of dermoid cyst arising from or near the left ovary was made.

OPERATION.—Laporotomy was performed approximately 7 weeks later. The tumor was exposed through a left para-median incision and a large cystic tumor was isolated. The pedicle was very vascular and densely adherent to the left fallopian tube, the tumor and tube were removed without rupture. The appearance of the uterus was consistent with a 3 to 4 months pregnancy. The patient's convalescence was uneventful and she was delivered of a normal child approximately 6½ months later. Labor was uncomplicated.

PATHOLOGY.—The tumor removed at operation consisted of a grayish globular mass 12.0 by 8.5 by 6.5 cm. and weighing 410 gms. Superficial blood vessels were distended and a constriction was present 4 cm. from one pole. On section, the cyst was filled with sebum and grayish milky fluid, hair was distributed throughout the contents, and the walls showed thickened areas, from one of which a canine and a premolar tooth were dissected. Teeth were of the adult type. Microscopically, the cyst cavity was lined with epidermis, sebaceous, and sweat glands, and also hair follicles were found beneath the epidermis; no ovarian tissue was found.

HISTO-PATHOLOGIC DIAGNOSIS.—Dermoid cyst (embryoma).

While the first case presented no question of surgical emergency, and the operation was one of election as to time, the second case was of a more urgent nature, presenting symptoms of a low bowel obstruction of undetermined cause, prior to radiographic examination.

[1] From the x-ray department U. S. Naval Hospital, Puget Sound Navy Yard.

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Case 2.—L. B., a well developed girl, 16 years of age, entered the hospital with the complaint of cramp-like abdominal pain localized in the left lower quadrant, nausea, and a history of vomiting three or four times during the preceding 3 hours. The patient retired near midnight after returning from a dance, and was awakened about 2 hours later by intermittent sharp cramp-like pain in the lower left abdomen, and believed she was suffering from food poisoning, or a return of a chronic colitis, which had been a troublesome childhood affliction. Her past medical history revealed no other serious illness. She had never had a serious injury or a surgical operation, and while she occasionally still had frequent small bowell movements, no intestinal parasites had ever been found on frequent stool examinations. Her menses had always occured at irregular intervals and were usually accompanied by severe abdominal cramps. She had just passed through a menstrual period prior to the onset of this attack.

PHYSICAL EXAMINATION.—The only significant finding on physical examination was an area of acute tenderness in the left lower abdomen. The urine was negative for albumin or sugar, the white blood cell count showed 13,350 leucocytes, 89 percent polys. The abdomen showed no distension on admission, but after 24 hours expectant treatment there was moderate distension, which was uninfluenced by enemas, and the white cell count had increased to 16,900, 87 percent polys, and two juvenile cells were noted in the Schilling's count. The sedimentation rate was 28 in 60 minutes. Forty hours after admission the patient exhibited symptoms of progressive toxicity, temperature 101°, and there was generalized abdominal distention, vomiting, and dehydration. In an attempt to localize the probable site of the bowel obstruction, single anterio-posterior and lateral films of the abdomen were made, and the rounded eminence of a tumor was discovered in the left lower abdomen. The tumor appeared to fill the true pelvis, all the distended coils of small bowel were above it, and the descending, transverse, ascending colon and caecum, could also be identified above it. A bicuspid and molar tooth were determined to lay inside the tumor from a comparison of the A–P and lateral films. A diagnosis of dermoid cyst of the left ovary, and compression of the sigmoid colon was made.

OPERATION.—Under ether anaesthesia, the abdomen was opened in the midline, and a large cyst, distended by a fairly recent hemorrhage was found filling almost the entire pelvis. It was quite densely adherent to the sigmoid colon, and the pedicle of the cyst showed that the body of the cyst had completed more than a complete turn. The resulting torsion of the pedicle had incorporated the left tube and ovary in the strangulated hemorrhagic mass. The tumor was freed from its attachment to the sigmoid colon, and together with the left ovary and tube was removed in toto from the abdomen without rupture. On the second post-operative day, the patient's temperature mounted to 103.8° with respiration of 24 per minute, and pain in the lower right chest. Chest films revealed almost a complete atelectasis of the right mid-lobe. This condition cleared rapidly under appropriate treatment as was shown by subsequent films, and the patient was discharged 18 days after her admission.

PATHOLOGY.—The extirpated tumor measured 11.9 by 11.2 cm., and consisted of a tough, fibrous sac, distended by fairly recent hemorrhage. When washed free of blood and detritus, a thickened hair bearing area was found near the upper pole of the cyst. Below this were several communicating cystic cavities filled with a buttery mixture resembling sebum. A fairly normal appearing molar tooth was situated in a thickened septa between the cysts. The crown of a bicuspid tooth was also present, the root structure as far as the neck of the tooth having been resorbed and presenting the appearance of a deciduous tooth at the time of extrusion. The pedicle appeared to arise from the inferior surface of the ovary. The ovary and a portion of fallopian tube appeared normal, and had probably only

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recently been incorporated in the hemorrhagic cyst. The recent hemorrhage had ballooned the cyst to such an extent that identification was impossible before the cyst was opened. The capsule of the tumor appeared to be intact with no microscopic evidence of malignant change. It appeared to be a simple dermoid cyst, designated as an embryoma.

Ewing [2] states that dermoid cysts constitute about 10 percent of all tumors of the ovary, and that approximately half their number contain teeth and rudiments of bone. Bowles [3] has recently pointed out the importance of roentgenograms of the abdomen in patients suspected of ovarian disease, or with symptoms referable to the lower abdomen. The approximate location of adhesive bands, inflammatory lesions, and tumors may frequently be determined by an anteroposterior film of the abdomen, and the recognition of teeth or bone in the tumor mass is pathognomonic of a teratoma.

Some confusion exists in the classification of cyst-like tumors arising from, or near the ovary as dermoid cysts, and then subsequently referring to them as teratomas. Especially is this so when it is also recalled that dermoid tumors are frequently found inside the skull, about the neck and in the post-anal region. In the chapter on tumors in Nelson's loose leaf surgery, Wood [4] has presented a very satisfactory classification on a histopathological basis. Simple ovarian cysts are subdivided into pseudomucinous and papillary cystadenomata. Teratomata are regarded as complex tumors developing from congenitally misplaced tissue, or masses of related tissue. To be classed as a dermoid, a tumor must contain tissue elements found in the dermis, such as sweat and sebaceous glands, hair, nails, or epidermal tissue.

Pseudomucinous cysts constitute approximately 50 percent of the cystic tumors of the ovary [4] and usually arise through absorption of the adjacent walls of small cysts, so that a large multilocular cavity is formed, and distended by a ropy fluid or jellylike mass, stained by blood pigment. The cyst walls are composed of fibrous tissue and lined by characteristic high-cylindrical epithelium. Beaker cells filled with mucin are present, except where they have been flattened and show pressure atrophy, when they may be filled with fat globules and cholesterin crystals. The rupture of this type of cyst in the abdomen with the implantation and growth of the living epithelial cells on the peritoneum, produces the spreading pseudomyxoma of the peritoneal cavity. Proliferation of this mass sometimes fills the abdominal cavity with jelly-like material that may cause death from malnutrition or bowel obstruction. Moolten [5] recently reported a

[2] Ewing, James: Neoblastic diseases, 3d edition, ch. XXX, pp. 655-666, W. B. Saunders Co., Philadelphia.

[3] Bowles, H. E.: Surg., Gynec. and Obst., 65: 340-347, 1937

[4] Wood, F. C.: Tumors—Nelson Loose Leaf Surgery, vol. 2, ch. 1, pp. 90-119. Thomas, Nelson and Sons, 1927.

[5] Moolten, R. R.: J. A. M. A., 106: 114-115, 1936.

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case in which the growth of such an ovarian cyst proceeded at such a rapid rate, that bowel obstruction occurred, though the tumor had not ruptured.

Papillary cystadenomata are characterized by papillary overgrowths from the cyst wall which grow through the encapsulating tissue and frequently appear as cauliflowerlike tufts on the surface of the ovary. In this stage of development, they are usually malignant. The cyst walls and papilla are lined with a low columnar epithelium which produces a thin serous secretion, more watery in appearance than the contents of pseudomucinous cysts; peritoneal implants of the epithelium readily occur, and are more frequently malignant than those coming from pseudomucinous cysts. Histologically, both types of cystic tumor are presumed to arise from ingrowths of the superficial germinal epithelium of the ovary and not from Graafian follicles or Pflügers cords which are ingrowths of peritoneal epithelial cells. Morphologically, the mucin cells of cystadenomata resemble cells found in teratomata which appear to be embryologic representatives of the mucin cells of the gastrointestinal tract.

True dermoid cysts are classified as teratomas and always contain sweat and sebaceous glands, hair, and tissue normally found in the dermis. Frequently associated with this tissue are many rudimentary structures of mesodermal and entodermal origin. They occur in many locations in the body, and can be traced to some embryologic folding or ingrowth of the ectoderm, or to some locality where dermal cell rests may occur, as inside the skull, abdomen, about the sacrum and coccyx, and the cervical region. New and Erich [6] reported the more frequent distribution of dermoid cysts encountered in 1,495 cases as follows: 44.5 percent post anal, 42.1 percent in ovary or contiguous structures, and 6.9 percent in the head and neck.

For purposes of further classification, dermoids may be divided into tumors arising in the embryonic remains of organs and those resulting from the late development of misplaced blastomeres. The former type of tumors arise in embryonal structures which normally atrophy during fetal life. Tumors arising from misplaced blastomeres are regarded as developments of totipotent blastomeres or of sex cells, and where only one tissue is present, its development is to be explained as the result of a growth stimulus to produce only this tissue, but the parent cells apparently are capable of producing all three primordial germinal tissues or their developmental derivatives. These tumors are found associated with the sex glands or their immediate adnexa. In the ovary and testicle three main types are differentiated, the complex teratoma containing vestigial reproduc-

[6] New, G. B. and Erich, J. B.: Surg., Gynec. and Obst. 65: 48-55, 1937.

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tions of adult structures, trachea and remnants of the gastro-intestinal tract. These tumors are usually present at birth, develop slowly, and rarely show evidence of malignant change.[2] The second class of tumors are rare, and are made up of multiple cysts containing embryonal tissue representative of any tissue found in the adult except the sex glands. The most usual tissue produced is neuro-epithelial or osteoid, and malignant changes of a chorio-epithelio-matous nature are common. The third type is the seminoma, composed of undifferentiated cells, usually showing early evidence of malignancy and extensive hemorrhage.

The first type of sex gland tumor, the complex cystic teratoma, is sometimes referred to as an embryoma and constitutes about 10 percent of all ovarian tumors. It may appear at any age, is most frequently discovered between the third and fourth decade, and is the most frequent of the ovarian tumors to appear before puberty.[3] They are quite frequently associated with simple mucinous or papillary cysts of the ovary [2] and only one small area in a large cystic ovary may be found to be a true dermoid. Their rupture may produce chronic peritonitis or symptoms of pressure and obstruction.[3] Macroscopically, they are encapsulated cystic tumors with the remnants of the ovary on one side and usually with a thickened area at one end which will be found to contain hair-bearing dermis. This feature was demonstrated in the gross specimen removed in each of the reported cases. At body temperature the tumor is distended by an oily fluid that solidifies on cooling, and in addition there are large amounts of detritus, sebum, fat and cholesterin collected in the multiple cysts, and in the septa, bone, teeth, muscle fiber and other differentiated tissues are produced. An interesting fact is that deciduous teeth are developed in cyst walls, while permanent teeth are developed in an osseous matrix. The cyst may be filled with hemorrhage if tortion of the pedicle has occurred.[2]

The origin of dermoid cysts is not definitely proved. The present view, concurred in by both Ewing [2] and Wood,[4] is that an ovum receives a parthenogenic stimulus to develop, and attempts to reproduce all parts of the embryo except the reproductive glands. The fact that cells may be dormant in the ovary for some time and then begin growth was demonstrated by a case reported by Granzow [7] in which a dermoid developed in an ovary 2½ years after the ovary had received 4½ times a castrating dose of x-ray. Infrequently the epidermal tissue in a dermoid may undergo malignant change. Ewing [2] states

[7] Granzow, Joachim: Abstracted article, Amer. J. Ront. and Rad. Therapy, 37: 714-715, 1937.

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such changes are present in about 3 percent of all dermoids, and believes microscopic sections from numerous areas should be examined in every case.

The second class of teratomas of the sex glands are solid tumors, made up of a heterogeneous mass of cells of an embryonal type. This tumor is quite rare in the ovary, usually makes its appearance before the age of 15 and is practically always malignant.[2] In the substance of the tumor embryonic cartilage, bone, neuroblastic and myogenic tissue is imperfectly reproduced. Metastatic lesions are sarcomatous or carcinomatous or may contain chorio-epitheliomatous or glial tissue.

A more benign type of tumor contains a preponderance of thyroid or adrenal tissue and sometimes produces clinical manifestations of hyperthyroidism. Chorioma ovarii occur infrequently. This tumor is more common in the testicle. Entwisle and Hepp [8] reported a case of testicular chorio-epithelioma in which the male breasts were distended by milk production, and the Ascheim-Zondek test for pregnancy was positive.

SUMMARY

Two cases of dermoid (embryoma) cyst of the ovary are reported because of the infrequency with which this condition is encountered in naval medical practice. The importance of x-ray examination of the abdomen is stressed, since single antero-posterior roentgenograms of the abdomen gave diagnostic evidence of the type of tumor together with its approximate size and location. The essential differences between cystadenomata and dermoid cysts of the ovary has been discussed, and a brief résumé of teratomata, their embryologic origin, and classification has been given.

SEASICKNESS

ETIOLOGY AND TREATMENT

By Commander J. R. Poppen, Medical Corps, United States Navy

Seasickness has intrigued the mind of man since he first began going down to the sea in ships. It has been a constant challenge to the medical profession. It has been studied from all conceivable angles and the theories about its etiology and treatment are limited in number only by the number of those who have given it thought, not excepting all of its hapless victims.

[8] Enwisle, R. M. and Hepp, J. H.: J. A. M. A., 104: 395-396, 1935.

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There is unanimity in a major premise that seasickness is a disability of equilibration. Unquestionably the physics involved in the production of the symptom complex is translation through gravitational planes. Mal de mer is maladjustment to gravity. Minor premises will be unsound and the reasoning false unless they comprehend all the physiological mechanisms and functions involved in equilibratory adjustment. It is just as false to reason that all cases of seasickness are caused by malfunction of the labyrinth as it is to reason that all equilibration is labyrinthian.

The study of equilibration in aviation has clarified a number of misconceptions and has served to ascribe a relative importance to the different mechanisms involved. The more wholesome contemplation of the subject resulting from these newer concepts makes it possible to supply minor premises to a truer reasoning on the cause of seasickness.

EQUILIBRATION NOT A SINGLE SENSE

The determination of position in space is not the sense of a single organ as vision is the sense of the eye. It is a function of three organs or organ groups, each preponderating in its significance depending upon the medium in which equilibrium is to be maintained.

In the free swimming aquatic phyla the **vestibular** function predominates. A fish has contact with gravity through a medium which uniformly distributes its force over the entire surface. It requires a teleoceptor for its information regarding the direction of gravity and we find the labyrinthian function highly developed in these phyla.

Terrestrial animals contact gravity through very small portions of their surface. Erect man makes this contact only through the soles of his feet. By comparison the support of the surrounding air is negligible. Terrestrial animals require a proprioceptor. We find this in the highly developed **somatic** senses.

A bird cannot depend upon either a teleoceptive labyrinth or proprioceptive somatic senses because the bird's body and the airplane develop within themselves gravitational forces which are greater than the earth's gravity. A flying animal must depend entirely upon orientation rather than equilibration. Man, without instumental assistance, cannot fly without **visual** contact with the earth.

In order to compare the relative significance of the labyrinth and somatic senses we will leave out of consideration the highly organized anatomic and physiologic association between them. Whether or not the former controls the latter, afferent impulses for which change of position in space is an adequate stimulus reach the central nervous system from end organs specifically inherent in the respective organs. In other words, awareness of rotation arises in the ampoule of the semicircular canals but the sense of falling forward arises principally

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from increased tension on the Achilles tendons. That the somatic senses are more important to human equilibration than the labyrinth is manifest by a number of fundamental considerations. To determine the relative importance of each it is only necessary to eliminate any two. Blindfold a deaf mute or one in whom the eighth nerve has been destroyed by disease and equilibrium is well preserved. Blindfold a tabetic and he falls.

There is no desire to minimize the importance of the labyrinth, particularly in its clinical manifestations. The victim of an acute labyrinthitis commands the pity due an excruciatingly abject sufferer. The localization of intracranial disease by careful labyrinthian function tests has the same appeal as a botanical key. But it is held wrong to attribute to the labyrinth exclusive control over equilibration. Indeed, human equilibration depends much more upon the somatic senses. Since this is true it follows that impulses for which change of position in space is an adequate stimulus will arise in the somatic sense organs in tremendously greater number than from the labyrinth. Then why the blanket indictment of the labyrinth for all sins against gravity?

DEFENSE OF THE LABYRINTH

In defense of the labyrinth as responsible for seasickness the following are offered as worthy of consideration in arriving at a verdict:

(1) Movements in the direction and of the magnitude of a ship in a sea produced on a Barany chair or tilting table will not stimulate the labyrinth to produce nausea. It is necessary that the canals be rotated by several rapid revolutions about an axis which at least approximates the axis of the canals before nausea is produced in the normal individual.

(2) Labyrinthian vertigo is pronounced as an accompaniment of "Barany chair nausea" but is a rare symptom in seasickness.

(3) Labyrinthian nystagmus is not described as a sign of seasickness but is characteristic of labyrinthian stimulation.

(4) A purely labyrinthian origin will not explain the sudden abrupt onset of symptoms after a long period of movement and without change in the direction and magnitude of the ship's movement, or will it explain the cessation of symptoms without change in movement.

(5) It will not explain individual variation. Within rather restricted limits all normal individuals should be made sick by the same sea.

(6) If the symptons are caused by an hyperirritability of the labyrinth the administration of strychnine and atropine should exaggerate rather than ameliorate them, yet these drugs are very effective in seasickness.

These points alone appear to constitute a sufficient alibi for the labyrinth. On purely physiological grounds it appears much more just to indict the somatic senses.

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INDICTMENT OF THE SOMATIC SENSES

A heaving deck and a weaving bunk will naturally produce a tremendous increase in the frequency and amplitude of afferent impulses which arise from the interplay of tensions in the skeletal organization. Many of these are disposed of by simple reflex arcs but there remains a veritable bombardment of these neurones and the higher centers.

The vertical components of the ships movements produce profound changes in the distribution and pressures in the large vessels. Alternate engorgement and draining of veins, repeated constriction and dilation incident to carotid bulb stimulation by hydrostatic changes in the carotids are a strain upon the autonomic system. Whether these mechanisms have central components or not they are certainly capable of ultimately resulting in somatic sensation if only by their effects upon the integument. The fatiguing effect of the multiplicity and complexity of these nervous impulses cannot be denied. These same forces operating on the viscera cause an almost constant change in the relative weight and pressures among these organs. The almost constant interplay of these pressures must result in the same sort of bombardment as delivered by the skeletal organization. That sudden pronounced changes of this nature can produce reflex changes is well known. Witness the sudden relief of weight in the pelvis incident to the sudden descent of an elevator, causing the quick inspiration, rigid contraction of muscles, and the familiar cremaster contraction. That lesser changes in weight and tension in the viscera have less perceptible but nevertheless significant central neurological components is difficult to disprove. Again, they at least set up afferent somatic impulses by action of the abdominal muscles and tendons. Certainly they cause splanchnic fatigue.

All of which is advanced only to establish that from a consideration of the physics and the accepted physiological processes involved it is much more reasonable to expect the adequate stimulus for the symptoms of seasickness to arise from somatic senses than from the labyrinth.

VISION

Vision unquestionably adds to the accumulation of afferent impulses either as directly stimulative or as inhibitory. Some victims find it comforting to watch the horizon and improve their orientation. Others are made worse by watching the sea.

PSYCHOGENIC FACTORS

Vision operates principally through still another common source, viz, the higher centers. The lady who seeks the rail before the lines have been cast off cannot have received sufficient stimulus from the

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labyrinth, the somatic senses or vision. The origin of her symptoms is purely psychogenic. Memory, association, apprehension, fear have a great deal to do with the production of seasickness whatever the underlying physiological mechanism. The sight of others in the throes of vomiting, the smell of cooking, the prospect of an unusually greasy meal will often precipitate an attack in one who has been holding his own.

Just as in airsickness in which the cause is practically always an unsatisfactory rationalization of fear; apprehension, concern for the safety of the ship and those aboard are often contributory. It is not always the skipper with his comprehensive responsibilities who is the only one aboard who is not seasick. A cargo shifting while the wind and sea abate can cause seasickness

Thus there are four mechanisms from which the stimulus for seasickness may arise; the labyrinth, the somatic senses, vision, and the higher cerebral centers. Most cases will present evidence of more than one being involved. The first three operate by delivering a veritable bombardment of afferent impulses upon the nervous system. The last operates somewhat by direct stimulation but much more forcibly by lowering thresholds of normal adaptive mechanisms. Under the influence of the bombardment, adaptation fails through fatigue or lowered thresholds, the nervous avalanche spills over and the typically medullary symptoms follow.

Any one of these four mechanisms may be of greatest significance but it is held that by far the worst sinners are the somatic senses and of their several components the arch demon is that stimulated by the interplay of tensions and pressures between the abdominal viscera.

There are many reasons for pointing the finger of accusation toward the abdomen. Practically all victims ascribe their discomfort to some alimentary cause; constipation, dietary indiscretion, the bon voyage banquet, etc. Relief from these besetments contributes to the relief of symptoms. Many cases are found in gastroptotic individuals. The relaxed suspension in these individuals permits exaggerated movement of the viscera.

CAUSES OF SEASICKNESS

Ascribing all due credit to the labyrinth and the higher cerebral centers for their complicity, the cause of seasickness is splanchnic fatigue. This fatigue results from a bombardment of afferent impulses upon secondary nerve centers. The bombardment results from the excessive and unusual interplay of tensions and pressures among the viscera and the skeletal organization. The medullary centers are the immediate origin of the symptoms. Anything which will lower the threshold of resistance or increase the fatigue will foster the development of the disease. *En passent*, anoxemia may be contributory to

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the fatigue even though oceanic atmosphere has never been noted for any anoxic qualities.

SEA LEGS

Then what are "sea legs?" As familiarity with the magnitude and periodicity of the ships motion increases, skeletal and visceral adjustments are effected more and more by the local reflex arcs with less and less central components. Adjustment becomes more automatic. As the visceral contents are made more normal the impulses from this source decrease in number and frequency. Add to these a more satisfactory rationalization of the apprehensive aspects and the nervous system becomes able to adjust itself to the relief of the medulla. Sea legs can be gained or lost. Loss is practically always of psychogenic origin.

CURE

Therapeutics must be directed toward primary causes. Efforts to restore fluid losses and acid-base levels are often necessary and must be carried out. But they are often disheartening in that they do not remove the cause. Sedatives, except in large doses, are often ineffective. Strychnine and atropine have met with great favor. The patient must be supported.

In those cases in which the psychogenic origin is strongest, cure can sometimes be effected by restoring confidence and reducing apprehension. This is not always possible and it is believed that the cases which become incurably chronic result from fear complexes which do not respond to ordinary psychotherapy.

When the underlying physiological cause lies in the skeletal organization cure can be effected by lying down. But if it be true that a majority of cases is caused by gravitational forces acting on the viscera, then efforts at prevention and cure must be directed toward reducing these effects. An effort must be made to reduce the movements of the abdominal contents.

By the use of a belt which covers the entire abdomen and has on its inner surface an inflatable bag it is possible to raise the intra-abdominal pressure. This produces a new, a higher plane of mutual pressures and the effects of extraneous gravitational forces are relatively reduced. In addition it effects a diversion of a certain amount of blood from the portal system into the general systemic circulation. This aids in reducing shock but the principal advantage of raising the intra-abdominal pressure lies in reducing the afferent impulses arising from the interplay of pressures among the viscera.

Such a belt has been tried in a small number of cases. Designed primarily for another purpose a belt was available during a recent cruise. The belt was applied and by means of a hand bulb the con-

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tained bag was inflated to between 1 and 2 pounds pressure. The results were uniformly gratifying and dramatic in celerity. One case may serve to illustrate the abruptness and completeness with which the symptoms ceased and restoration of normal conditions followed.

A recruit on his first cruise, assigned to duty as a mess cook, had exhausted all his determination and staggered to the sick bay for relief. Vomiting and retching with typical regularity, "green" facies, cold, clammy skin, etc., he was the picture of the stage of hoping he would die. The belt was applied and inflated to about 2 pounds pressure. The cessation of retching and the return of color and composure were truly dramatic. A glass of water was retained followed by a cup of coffee. In a few minutes a cigarette was enjoyed. After maintaining the pressure for about 30 minutes, during which his fluid losses were replaced, it was eased off slowly. He was completely relieved. By giving him complete though temporary relief it was possible to restore his fluid losses, his faith in himself and his love of the Navy. It tided him over until he found his sea legs. He left the sick bay with, "I gotta set up my tables. Roast pork today!"

CONCLUSIONS

(1) The etiology and treatment of seasickness have been studied on the basis of the physiological mechanisms of equilibration.

(2) The peripheral origin of the impulses producing seasickness may be (*a*) the labyrinth, (*b*) the somatic senses, (*c*) vision, and (*d*) the cerebral centers. By far the commonest is (*b*) the somatic senses and of their components those arising in the abdominal viscera are the commonest.

(3) Under the influence of fatigue and lowered thresholds the multiplicity of stimuli arising from these sources escape from reflex and subcortical control and produce the symptom complex by medullary stimulation.

(4) A means of treatment which reduces the afferent impulses arising from somatic tensions among the abdominal viscera by increasing the intra-abdominal pressure has been described.

SEASICKNESS

By Lt. Comdr. Morris Brooks, Medical Corps, United States Naval Reserve

Seasickness (naupathia, mal-de-mer), is "a disorder of uncertain nature, affecting travelers by sea." [1] This disorder may occur on shore and in the air as well as on means of conveyance other than a ship.

[1] Stedman's Medical Dictionary, 3d edition, p. 833.

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There are people who get sick in a trolley, automobile, train [2] or merry-go-round, especially when riding backward. One may feel mildly seasick in one's own home "in a stuffy room, when the assembled company smokes too much and drinks too much." [3] The youth who smokes his first cigar may well imagine himself seasick. Children sometimes get sick from swinging or seesawing. The country lad "going down" for the first time in a high-speed elevator may feel his stomach "going up." Robinson Crusoe described his sensations during an earthquake, ". . . and the motion of the earth made my stomach sick like one that was tossed at sea." Middle westerners, terrified by the approach of a cyclone have been known to disgorge and feel like a seasick person. During the late war many a brave lad felt sick when "going over the top." Skiing has been known to produce nausea and vertigo. Vomiting may occur after marathon races and rowing regattas.

It may occur before the ship leaves the dock, due to revolting sensory impressions, such as the smell of the bilge, or of the rubber and engine oil.[4] Cases have occurred when at anchor in a calm sea. Keevil records a case occurring ashore after severe mental shock, in a patient who had a long past history of seasickness. White men in Peru may suffer from *soroche*, mountain sickness, which causes vomiting, fainting, and almost unbearable headache.[5] Riding a camel frequently causes motion sickness (possibly because of the more lateral motion), while riding a horse rarely, if ever, does.[6]

Children with a previous history of cyclical vomiting and women in the late months of pregnancy, having ceased vomiting in the early months, may vomit soon after coming on board.[7]

IMMUNITY

No one is immune and no age is exempt. Infants under 2 years are seldom affected.[8] Children under 12 years seldom suffer severely.[4] The elderly, as do some heavy drinkers, stand sea travel rather well.

Hill [9] considers seasickness a normal response to an abnormal environment, and the relief and immunity which tend to occur with repetition as a part of the normal response. Relatively immune, according to Dr. J. Bohec of the *Ile de France*, are those with hypertension, the feverish, the deaf and dumb, tabetics, rope walkers, acrobats, dancers, young children, and the insane.

[2] Hirsch, Caesar: Deutsche Med. Wochenschrift, 57: 494, 1931.
[3] Montague, J. F.: Why Bring That Up, 1936 Home Health Library, N. Y.
[4] Bennett, R. Allan: Brit. Med. Jour., 1: 752-754, May 5, 1928.
[5] Fortune Magazine: 17: 56, 1938.
[6] Toubib, Robert: Hygeia 15: 593-596, 1937.
[7] Jones, R. Sydney: Brit. Med. Jour., p. 139, January 17, 1925.
[8] Oriel, G. H.: Lancet, 2: 811-813, 1927.
[9] Hill, John: Brit. Med. Jour., 2: 802-807, 1936.

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The type of vessel seems to have no bearing on the matter, though a person unaffected on a sailing vessel may suffer on a liner. A sailor immune on a battleship may be overcome by the movement of a destroyer or submarine.

That the sea is very impartial may be gathered from these facts: Lord Nelson, of Trafalgar fame, was a victim during his entire naval career. Seneca and Cicero were susceptible, as was Julius Caesar.[3] Homer records that Ulysses suffered from naupathia. The First Lord of the Admiralty, suffered from seasickness on a trip to Malta.[10]

Nor are animals immune.[3] Caesar records difficulty in the pursuit of the enemy in his African wars because his "horsemen had beasts of burden which were weary in consequence of recent nausea." During the World War horses were reported lying down, in a cold sweat, and groaning. Poultry and songbirds, transported by sea, often become seasick. Monkeys, though accustomed to being aloft in swaying trees, are subject to mal-de-mer. A quantity of fish being conveyed from the Galapagos Islands to the New York Aquarium were reported seasick by their scientific expedition. Trained seals en route from England to America gave signs of seasickness.

ETIOLOGY

An entirely satisfactory etiology for this ancient malady has never been worked out. There are many theories, but no sole cause. Beckman[11] is of the opinion that "all of them operate to some extent in varying proportions in each case."

Hippocrates described this ailment as due to the movements of the sea; and the word nausea is derived from the Greek *naus* for ship.

Predisposing Factors

Many believe, with Keevil,[12] that vagotonia is a hereditary quality.

There are those who hold that seasickness occurs in the maladjusted state; that those races which show the greatest degree of adaptability to altered environment are most free from seasickness. Thus they point to the English, the greatest colonizing race, as having a high immunity. The French readily admit to mal-de-mer. The Chinese are good sailors; the Malays and those who live in fishing boats are readily adaptable. On the other hand the Semitic people are poor travelers at sea.

The lean, anxious types, who readily acquire cold and clammy hands and feet, have an unstable vasomotor control, are subject to easy blushing, and who suffer from borborygmi on slight tension are likely

[10] New York Times: November 14, 1937.
[11] Beckman, H.: Treatment in General Practice, 2d edition, p. 767. W. B. Saunders Co., 1934.
[12] Keevil, J. J.: J. Roy. Nav. M. Serv. 21: 216–231, 1935.

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candidates. By contrast, the well-nourished, even-tempered athlete or cooperator in group activities is likely to be immune. Desnoes has noted that the indolent life of many Latin-American women makes them most susceptible.

ANTICIPATION is the chief predisposing cause, according to Bennett; the impressionable passenger who has made up his mind that he is going to be sick may turn pale as he crosses the gangplank. Pavlov made a dog seasick in a cage constructed to imitate the motions of a ship; after recovery the dog became seasick when confronted with the cage, and refused to go aboard.

FEAR.—"The emotional expression to unusual and irreconcilable stimuli which cannot be translated into effective action" produces the sensations described as "paralyzed with fear," "sick with horror," "cold feet," "a sinking feeling." This fear is distinct from cowardice, and is manifested as seasickness in an individual with limited control over the vegetative centers.[12]

CHRONIC INDIGESTION, often with constipation, aggravated by the excitement of preparing for the trip, is a frequent predisposing factor. Out of 100 consecutive cases noted by Bennett, 88 had overeaten and 74 were constipated.

ODORS.—Susceptibility to odors is one of the most active causes according to Montague and others. Strong odors of food, as garlic, onions, and cheese or heavy perfumes and flowers, or especially of old cigar stubs, often start an attack of nausea.

Howard P. Arnold [13] asserts that "the cleanliest steamer abounds in fumes compared to which the 2 and 70 stenches of Cologne are as the perfumes of Araby."

The report of the New York State Commission on Ventilation [14] is elucidating. More important than oxygen or carbon dioxide in occupied rooms is the ill-defined odoriferous organic matter arising from foul breath, sweat, and sebaceous secretions (especially when personal hygiene is deficient), gases from the alimentary canal, and decomposition of matter in the skin and clothing. Man's sense of smell is extremely sensitive to inconceivably small concentrations of odoriferous matter that cannot be detected by known methods of chemical analysis. Such odors are not known to be harmful but they certainly induce a feeling of stuffiness and odor discomfort on entering a room from outdoors. Under extreme conditions headache, nausea, loss of appetite, and a disinclination for physical activity may result in sensitive persons.

[13] New York Times: Magazine section, p. 14, May 30, 1937.

[14] E. P. Dutton and Co., 1923, quoted by C. P. Yaglou: J. A. M. A., 108: 1708–1713, 1937.

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Hypoglycemia, cyclic vomiting of children, some forms of endocrine dysfunction, migraine, pregnancy with disturbed metabolism, and nephritis are apt to produce severe seasickness.[8]

THEORIES.—(1) *Labyrinthine theory.*—Upset is caused by overstimulation of the equilibritory organs in the internal ear, with resultant overflow of stimuli to other centers and the vagus nerve.

The old sailing ships, even in calm weather, were rough on the seasick. Benedict[13] writes "we rushed on through the calm seas with our top-gallant masts swinging at an arc of 30° or more." Paddle wheelers were particularly distressing. Harriet Beecher Stowe[13] wrote: "Even in the calmest sea the ship rocks from side to side with a steady, dizzy motion like that of a cradle." The screw steamers provide a racking, merciless throbbing. Says Ella Thompson: [13] "A screw steamer is like riding a gigantic camel that has heart disease and you do not miss a single throb."

This theory was popular but unproven, with voluminous and conflicting opinions. Jelliffe and White [15] think the disturbance of the labyrinthe due to continuous movement of the endolymph, and irritation of the receptors is the only cause; that the stomach has little or nothing to do with seasickness; but admit that eye movements aid in causing seasickness.

(2) Confusion results from the *multiplicity of unusual stimuli* to sensory nerves of adjustments of our bodies in space.

The brain of the seasick patient is a welter of conflicting perceptions. Those derived from the retina and oculomotor muscles record the position and movements of the head in relation to its immediate surroundings. But perceptions from other receptors, particularly the labyrinth, are simultaneously registering the movements of the body in space relative to the direction of gravitational force—movements in which the ship itself participates. These two groups of sense perceptions are incompatible, each competing for the nervous path of appropriate response.

(3) *Eyestrain* caused by the glare of sea and sky, and the unusual fixation upon moving objects, has been advanced as a cause.

The ocular theory stresses the fatigue of the eyes in following a world in continuous motion. Those with "eye trouble" are particularly sensitive.

(4) The wide excursions made by the freely movable organs of the abdominal cavity cause *vagus nerve irritation.*

Lenggenhager [16] presents the theory that the disturbances characteristic of sea, air, and train sickness are not elicited by the labryinth

[15] Jelliffe, S. E., and White, W. A.: Diseases of the Nervous System, p. 418, Lea and Febiger, 1935.
[16] Abstracted in J. A. M. A., 106: 2203, 1936.

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but rather by fluctuations in the pressure and traction exerted on the large sympathetic nervous plexuses in the epigastric region.

(5) *Autosuggestion* probably accounts for some cases.

Halifax has stated "a man may dwell so long upon a thought that it may take him prisoner."

Particularly predisposing is the reading of articles by authors who have had stormy voyages. Mrs. Ella Thompson[13] refers bitterly to "that greenest of all green lemons, a trip across the ocean." A clergyman writes: "If God would forgive us, we should not commit the sin of going to sea a second time." Charles C. Fulton states "in planning a trip abroad, the voyage across should not be numbered among its pleasures." Many books on travel are written with emotional intensity, and describe the authors' sufferings from seasickness.

(6) *Acidosis.*—According to Oriel[8], of the Canadian Pacific steamships, in cases of vomiting there are present in the urine, acetone, diacetic acid, and ammonia up to 265 mgm. percent. Sidney Jones, of the *Aquitania*, thinks that 99 percent of cases of vomiting at sea, not due to an organic lesion, are accompanied by increased acidity and acetonuria. However, others believe the acidosis to be a result, rather than a cause of seasickness.

(7) *Neurologic theories* of vagotonic and sympatheticotonic types. These were first defined by the Germans Eppinger and Hess in 1910, and elaborated by the French, who added the types hyper-sympatheticotonic and amphoneurotonic. Bohec's term, amphoneurotonic, can be used for all cases at all stages of seasickness.

(8) *Visceroptosis.*—Barclay, of London, has shown that profound changes may occur in the shape and position of the abdominal viscera as a result of mechanical and mental influences. Smith and Feiling have demonstrated that visceroptotics are prone to vasomotor instability, depressed and anxious mental states, and lack of adaptability to environment, while their chief complaints are abdominal discomfort, dragging sensations, constipation, flatulence, and attacks of vomiting.

(9) *Movements of the ship.*—The four single movements of a ship are pitching, rolling, yawing, and scending. Scending (the upward movement of a vessel in a seaway) is supposed to be the most nauseating, with pitching a close second.

Keevil does not believe seasickness is due to any single rhythmical movement, but is caused by a combination of various movements, probably increased by the continuous vibration of the modern ship, and aided by the thud of the propellers and the whir of the ventilating fans.[3 17]

[17] Desnoes, P. H.: J. A. M. A., 86: 319–324, 1926.

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DIAGNOSIS

SIGNS AND SYMPTOMS.—This description was written by André Chenier after crossing the English Channel in December 1787.

Therefore, when the agile tiller, often
From Dover or from Tangiers, cleaves the mobil way,
In the depths of the black ship, a prey to the rolling wave,
The passenger languishes, sick and tottering.
His darkened gaze dies. His heavy head
Veers like the wind which blows up in his disgusted bosom,
As from bound to bound the ship is borne along.
Sad and pale he lays himself down, and the bitter nausea
Heaves his bosom, and from his mouth a long flood
Which pollutes the carpets destined for repose.
He would now view, without chagrin, death or shipwreck.
Stupified, he has lost both force and courage;
He cannot use his stiffened members;
He can neither help his friend nor yet his son,
Nor support his father. His slow and feeble hand
Seeks vainly to clasp the hand of his expiring wife.

Erastus Benedict describes his trip across the English Channel. On boarding the boat he found all the female passengers and many of the gentlemen "stretched out on deck, their heads resting on their hands or a piece of hand luggage, with a common washbowl beside them." They were seldom disappointed in their expectations.

Bennett describes a mild attack as beginning with yawning or sighing, then nausea, and the last straw is supplied by the smell of a cigar or by a chance remark. Retching continues with the stomach empty. The hands and feet are icy, the face is pale, there is a cold sweat, the pulse is feeble and slow, there is occipital headache, with dizziness and vertigo. The blood pressure is low. The tongue is furred, the mouth is dry, and the taste is bitter. The mental effect in some is slight; "others have a strong conviction that death is imminent, followed as time goes on by an unreasonable annoyance at its delay." There is usually improvement in 24–36 hours; in a few the vomiting may continue, hiccup may occur, and the mental depression increases. As in sickness after excessive smoking, disordered action of the pneumogastric nerve appears responsible.

Keevil states that in seasickness the respiration is slow and shallow; unconsciousness is absent; the blood pressure does not fall. The pulse rate may fall to 40, especially under belladonna medication, and is rapid and irregular during and shortly after emesis. Atropin improves the symptoms without reducing the bradycardia. The upper segments of the abdominal recti muscles are in contraction; the descending colon can often be palpated in spasm; and the rectal sphincter is in spasm. Emesis produces notable relief, possibly with a period of exhaustion, but also with mental improvement on account of the return of cortical control over a hypotonic vegetative system.

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The tendon jerks are increased at first, later diminished. The increased pharyngeal reflex indicates irritability of the glossopharyngeal and vagus nerves. The pupils dilate during emesis. Nystagmus is absent. The temperature is subnormal. The volume of urine is diminished. The vomitus is a mixture of gastric and duodenal contents, and is highly acid like the hyperchlorhydria of anxiety states. The stools are mucous.

Desnoes [17] gives salivation and frequent swallowing as occurring often in seasickness, and describes the pallor with greenish hue. The facial expression, which depicts great dejection and apathy, faithfully records the internal feelings.

DIFFERENTIAL DIAGNOSIS.—Serious organic conditions may run a concurrent course and be obscured by an attack of seasickness.

The most common [8] is acute appendicitis, which may mimic the signs of seasickness with vomiting, abdominal pain, and headache. In seasickness however, the abdominal pain does not cause rigidity, there is no rise in temperature; an hourly chart of the pulse, temperature, and resperation, will aid in diagnosis.

Acute intestinal obstruction may be a complication, brought on by the strain of vomiting. The pain in obstruction is far more severe; a careful abdominal examination, and the results of an enema or two will clear up the diagnosis.

Seasickness may mask a perforation, though here the severe pain, rigidity, and collapse are usually pathognomonic.

Typhoid, paratyphoid, and the prodromata of the acute contagious diseases should be kept in mind. Constipation itself may produce some of the symptoms of seasickness. Diarrhea often accompanies seasickness, but may be of independent origin. Cystitis, due to the concentration and high acidity of the urine, may be a sequel. Headache may be independent of, as well as coincident with, seasickness.

TREATMENT

There are a thousand and one remedies, ranging from the practical to the ridiculous. To stay at home to avoid mal-de-mer is as practical as to avoid domestic trouble by not getting married. The most ridiculous (to lie in the shade of an old oak tree) is most likely to work.

PROPHYLAXIS.—Make your sailing plans as far in advance as possible. Get a good cabin-class ship, not necessarily a luxurious liner. The presence of a gyro stabilizer will considerably overcome the roll of the ship, and diminish the pitch. An inside stateroom in the middle of the ship is most desirable.[3 15] Avoid the height of the season, and

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book return passage in advance. Have all preparations completed 24 hours before sailing time, with all bags and baggage on the ship.

Diet.—For several days before sailing limit yourself to two meals a day. Reduce the amount of alcohol and smoking. "He who spends his last days ashore in feasting and farewells will reap what he has sown." [4]

For those predisposed Jelliffe and White [15] recommend dispensing with the pre-breakfast walk and try eating some fruit or light food, even before rising; or go directly to the breakfast table.

Oriel [8] also advises that it is a common error to avoid food, thereby exhausting the glycogen reserve, with acidosis as a sequel. Besides, vomiting something is easier that retching with an empty stomach.

Active occupation.—This is of proven value both as preventative and treatment. The treatment by mental distraction or displacement subordinates the stimuli of seasickness to more dominant ones.

Lord Exmouth, in the frigate *Nymph*, captured the *La Cleopatre* though his crew of Cornish miners, previously incapacitated by seasickness, overcame their disorder during the fight.[3]

Dr. Victor Heiser [18] records his personal experience on this subject. "A still better cure is to have some absorbing interest to divert the mind. Once in weather so rough I could hardly stay in my bunk, where I was coddling myself, a sick call came from the steerage. I somehow staggered to my feet and answered it. Shortly I became so occupied that I forgot all about my unpleasant nausea."

If possible, be up on deck in the fresh air [3 4 11], though some are too embarrassed by their illness and can relax only in their cabins. Walk around the deck, try to acquire the wide swinging gait of the sailor; do not try to walk in the straight manner of the landlubber. Breathing exercises have an action on the diaphragm and on the sympathetic system. Respiratory rhythm prevents the sudden forcible action of the diaphragm, which was shown by Magendie to be the cause of emesis.

Card games, and other games which hold the interest are helpful.

Miscellaneous.—Swallowing small chunks of ice or sipping cold ginger ale or champagne may dispel oncoming nausea. Champagne has been used from time immemorial, even on the prow of the ship when launched—though not to prevent seasickness. It is quite palatable to most, helps allay fear, and produces some muscular relaxation.

A tight abdominal binder is recommended by many to support the viscera, especially in those with visceroptosis. Montague prefers

[18] Heiser, Victor: An American Doctor's Odyssey, 1936. W. W. Norton & Co.

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a belladonna plaster over the solar plexus. Beckman, as a ship surgeon, recorded the case of an officer who became quite ill whenever he removed his binder in a heavy sea.

Eyestrain.—A few avoid illness by remaining in their darkened cabins throughout the voyage. However, blind persons may be seasick. Some people wear smoked glasses on deck. Avoid using the eyes as much as possible, reading for short periods only. In general it is better to watch the sights on board ship or far off at sea, not close by.

Posture.—The prone position with the head raised very little, if at all, is best, facing away from the sea. Avoid sudden movement in bending forward or getting up. Keep to windward of the galley to avoid the odors of cooking food.

Tobler [19] supports Lenggenhager's theory, and cites the following interesting case as corroborating evidence. A girl, 10 years, was subject to auto sickness when traveling through the mountains, and the usual remedies were without avail. To avoid pressure and traction on the abdominal viscera, the child was placed prone on an upholstered board. During 2 hours of travel over mountainous roads the child remained free from all signs of auto sickness. However, as soon as the child left the prone position there was nausea and vomiting. When the prone position was resumed, the child again tolerated the auto trip without difficulty.

Plugging the ears is supposed to overcome the tendency to nausea and dizziness by pressure on the semicircular canals, and if tightly packed by removing some unpleasant auditory stimuli. Beckman thinks it is probably psychic. The late President Coolidge used local anesthetics on cotton ear-pledgets.[11]

On ships equipped with a modern gyro stabilizer it is possible to eliminate as much as 90 percent of the ship's roll and considerable of the pitch.

MEDICATION.—Leiri [20] regards atropine as the most effectual remedy for seasickness. It paralyzes the parasympathetic and thus prevents the reflex action from the vestibule which is started and maintained by the unusual movements of the ship. He explains why epinephrine has to be used with it.

Keevil gives an initial dose of tincture of belladonna, followed by 20 minim doses tid.

Bohec [21] believes the tincture of belladonna (which contains hyoscyamin) to be twice as effective as atropin as a vagal paralyzer. He

[19] Tobler, W.: Abstracted in J. A. M. A., 109: 2172, 1937.
[20] Leiri, F.: Abstracted article, J. A. M. A., 87: 136, 1926.
[21] Bohec, J.: La Presse Medicale, 38: 21–22, 1930.

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prescribes a tablet of bellafolin (containing the total alkaloids of belladonna) every 2 hours for four doses, and 1 prn. for gastric spasm or nausea before embarking and during the first few days on board ship, especially for the vagotonic and those who fear seasickness. For severe vomiting and prostration he gives 0.5 mg. bellafolin by hypo. This may be repeated in 6 hours. For the sympatheticotonic or hyper-sympatheticotonic he uses benzyl benzoate, sodium nitrite, ergotamine, etc.

Hill [9] depresses the inhibitory forces with the tincture of belladonna, 30 mm. spread over 4 hours. For those who vomit readily try 3–4 drops of the 1 percent solution of atropin sublingualy or a suppository containing hyoscine. In the early stages of vagotonic seasickness try strong tea or coffee, supplemented by vigorous deck games. Vagotonics should be encouraged to eat. Therefore they should not be given hypnotics or drugs which impair the appetite, e. g. chlorbutanol (chloretone, "Mothersill," etc.). For the excitable (sympatheticotonic) he prescribes sedatives; alcohol in various forms, the barbiturates, bromides, and chloral hydrate. Chlorbutanol should be reserved for excessive vomiting. He thinks a panacea against seasickness is but an idle fantasy. Recently he has tried benzedrine sulphate in 10–20 mg. doses.[22]

Desnoes, one time port medical officer of the United Fruit Co., has secured the best results with scopolamine hydrobromide 1/400 gr. by mouth every hour until relieved; or teaspoon doses every hour of the following prescription:

Scopolamine hydrobromide	1/50 gr.	0.0013
Spirits peppermint	3 mm.	.2
Elixir lactated pepsin, ad	1 oz.	30.

In cases with much depression strychnin sulphate 1/60 gr. may be added.

Hirsch [2] of Stuttgart, himself a chronic sufferer from seasickness, speaks of atropin by hypo as the best remedy, and finds scopolamine and hyoscine useful.

Neuberger [23] tried the administration of carbon dioxide by the use of rebreathing bags on 500 midshipmen on the U. S. S. *Wyoming* in 1936. The results were disappointing. His best results were from the use of 5 grains chlorbutanol repeated for 2 or 3 doses.

Bennett, surgeon Pacific Steam Navigation Co., recommends bromides in 10-grain doses. (Other authorities condemn the use of any bromides because of their gastric irritation.) He uses chlorbutanol, nitroglycerine, and amyl nitrite, as indicated.

[9] Hill, J.: Brit. Med. Jour., 2: 1109, 1937.
[22] Personal communication.

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Beckman and Desnoes also speak highly of chloretone (chlorbutanol); 5–10 grains in capsules, repeated in 6 hours sos. Besides inducing sleep this remedy has an anesthetic action on the gastric mucosa.

Solis-Cohen [24] states "chloretone is a gastric sedative and is given with good effect to relieve the pain of ulcers of the stomach and gastralgia, and to check vomiting especially that following general anesthesia and in seasickness."

Carminatives are not much in vogue, but soda bicarbonate to relieve the bitter taste is popular.

For the cases with low blood pressure adrenalin and similar preparations are recommended.

Liver extract, orally and intramuscularly, was not found effective.

Sidney Jones first used glucose on the basis that seasickness is an acidosis. Oriel studied this extensively at sea and concluded that glucose relieves the symptoms of seasickness by causing diuresis, abolishing the acetonuria, and by reducing the ammonia excretion. He gave 12-gram doses to over 1,000 patients, and found its effects superior to atropin, strychnin, belladonna, chloral, bromides, alkalies, and various patent remedies. For children he prescribes rectal injections of sodium citrate, 1 dram to the pint of water, repeated prn., and gives citrus fruits by mouth.

SEASICKNESS

FROM A PATIENT'S VIEWPOINT

By Lt. Comdr. Willard S. Sargent, Medical Corps, United States Navy

No condition given in current textbooks so aptly describes the feeling of real seasickness as does that under the heading of toxemia of pregnancy. When one is really seasick, he freely gives the best that is in him; and since the cause continues, hope of relief often seems to be in the far distance.

My prolonged personal experience as a victim of seasickness has provided much of the material and stimulus for this study. As a boy I always got sick when riding in the back seat of the old white-topped buggy. Street cars and back seats of automobiles always give me distress.

ETIOLOGY AND PATHOLOGY

Seasickness is not psychic. There are always aboard any ship a certain number who feel they know everything about medicine including seasickness, and they are always ready to give and force their

[24] Cohen, S. S.: Pharmacotherapeutics, materia medica and drug action, D. Appleton-Century Co., New York.

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views on him who is seasick; yet the most astounding fact discoverable is their extreme ignorance of fundamental and basic pathology; it is the general lack of knowledge which makes them so cocksure. One can label a case psychic only if before sailing he becomes affected or if he is affected by seeing or hearing of someone else who is seasick. Many a person wakes up from sleep because he has to vomit.

Individuals vary in their response to the ship's motion; some are not affected at all while others are extremely ill. The size of the ship affects the motion and therefore the patient, and the weather conditions and the direction taken by the ship largely determines the motion of the ship. The same individual may be worse on one voyage and better on another with the sea about the same in each case. The condition of the person when he comes aboard, his experiences with drink, banquets, etc., the night before, and the ventilation and odors, especially oil aboard ship, all have some bearing on his response. The condition of the bowels is often mentioned as predisposing. Some get their "sea legs" quicker than others although they are just as sick at first. The majority who get sick are usually worse the first 2 or 3 days, other things being equal, but some however never get over being seasick.

The condition apparently affects the eye, labyrinth, and general sensorium. There is a disturbance of orientation. It has been claimed that deaf mutes do not get seasick and that bilateral section of the eighth nerves will cure seasickness; this suggests the labyrinth as the organ particularly affected and it seems to be related to the movement of the endolymph stimulating excessively the ciliated epithelium of the canals and vestibule and thereby giving faulty interpretation of pressure of the endolymph. If a person is able to compensate for this he gets over the seasickness; if not he continues to be sick. The vestibular never connects the labyrinth by way of the medulla with the cortex, cerebellum, and spinal cord. Its connection by way of its nuclei with the nuclei of the third, fourth, and sixth cranial nerves through the medial longitudial fasciculus explains the nystagmus that occurs in some while its connection with the nuclei of the vagus and phrenic nerves explains the vomiting and nausea. The gastric symptoms including pylorospasm are only reflex. Noises and ringing in the ears in some speak for cochlear disturbance. The excessive impulses going to the cerebellum may account for the posterior headache.

Dehydration and scanty urine may follow from vomiting, lack of eating and drinking, and from perspiration. Loss of weight is very apt to occur; I lost 30 pounds within 6 months. People who have ailments such as middle-ear disease, sinus trouble, gall bladder, gastric or colon trouble, seem to be affected more than if they had no such trouble. Old diseases that have been quiescent may be

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lighted up by seasickness since the latter markedly lowers resistance, and new affections may arise during this period of low resistance; noteworthy is the common cold. People have been known to vomit ascarus lumbricoides; this is evidence of the violent gastro-intestinal disturbance caused.

SYMPTOMS

The person feels discomfort, has anorexia, gets dizzy, often perspires, may note ringing in the ears, looks pale, is depressed, may become constipated or develop diarrhea with passage of mucus, may be unable to read, study, or watch movies, often has salivation before and during the sickness, may become exhausted or prostrated, and while collapse may occur, death very rarely if ever follows. Acidosis, dehydration, and scanty urine often occur; even alkalosis occurs in some when vomiting is excessive. Some feel well enough to do some work and even play games. Nystagmus may occur in severe cases and the blood pressure is usually low.

The three most marked and common symptoms are vomiting, headache, and dizziness. The vomiting may be mild to almost continuous. Nausea and retching without real vomiting is often very annoying. Bilious vomiting is very distressing and even painful. The headache may involve any part of the head and is of a dull heavy type. It most often involves two regions: Firstly, anteriorly over a triangular area, the base of which runs horizontally through the center of the frontal bone, and the sides run from the temples to the nose, including the eyes and sinus region; and secondly, posteriorly just below the external occipital protuberance in the midline and in the area of the suboccipital triangles more laterally.

DIAGNOSIS

The important point here is that some serious condition may be missed when the patient and doctor think that only seasickness exists. I had a case of severe bleeding from a duodenal ulcer that in the first few hours before blood appeared was thought to be seasickness. The history of the patient with past sea-going experience, the weather, the size of the ship, the motion of the ship, and the time the patient first noted the sickness are important points in differential diagnosis.

PREVENTION

For a few days before sailing, a person who is subject to seasickness should drink freely of water, see that the bowels move normally each day, and should eat easily digestible foods, avoiding greasy or slimy preparations. Fruit juices are very good. Overloading is unwise, and it is wise to avoid parties, banquets, and indulgence in liquor.

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The night before sailing a good night's sleep should be had. Bromides or chloretone may be taken thrice daily for a few days before going aboard. If any trouble of sleeping arises sodium amytal is wisely given.

After getting aboard and underway, it is well to go to bed for awhile. A hot drink on arising will help some. Sodium amytal the first night out is often very valuable.

TREATMENT

I have tried personally everything I have ever heard of for seasickness and have tried practically all of them on others as well. While the seasickness is bad, it is best for the patient to go to bed and keep warm. Osler advocates lying on the right side with the legs curled up. This may assist the stomach to empty itself (especially of liquids) into the bowel; however a number of my patients, including myself, feel much better lying on the back. Fresh air in the room is a great help. After improvement occurs it is often wise to get up on deck in the fresh air. Deep breathing may also help. The use of swings, hammocks, swinging chairs, and air pillows have been disappointing to me.

I see no reason to abstain from liquids because the danger of dehydration and scanty urine production is ever present. In fact many can take liquids, especially water, when solid foods are ejected. Alkaline foods are especially desirable. Some feel that lemon juice or sour pickles are of value; my answer can be seen in the query: "Have you ever vomited up a sour pickle?" After vomiting subsides simple foods should be prescribed as for a post-operative diet. Low enemas are preferable to catharsis. Cold to the forehead or heat to the cerebellum are not curative but may be of some help just because they feel good. I have never used lavage or duodenal drainage.

Cotton in the ears may help slightly from the pressure which is relayed to the oval window of the labyrinth and some have welcomed it to help reduce the noise when ringing in the ears is present. When a person goes to the toilet he often becomes more seasick, and some have found temporary relief while there by resting the head in the hands and pressing the thumbs in the external auditory canals. I have tried almost every drug ever mentioned for seasickness. Some of them are directed against the stomach, and since the gastric symptoms are reflex, the fallacy of such measures is evident. Others are directed against the brain or nervous system, and while the same argument applies, a person may be benefited somewhat by depressing the reception of impulses during which period the body may learn to compensate for the endolymph stimulation in the labyrinth.

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The bromides have done little good in my experience. They are often given both as a preventative and curative. They seem to be too mild for the real seasick patient. They depress the entire body including secretions and thereby may increase constipation. If given after the ship sails they should be given in capsule or effervescent form because bad taste often makes conditions worse. This holds true of any drug.

Chloretone in 3- to 5-grain doses tid. has seemed to help milder cases at times. It is a gastric sedative and a hypnotic. It does not depress the circulation or irritate the stomach as does chloral. Chloral has not been of value in our cases.

Amyl nitrite further depresses the circulation and further lowers the blood pressure which is already low; sodium nitrite acts similarly but slower. I tried amyl nitrite but once. It did no good and was very fleeting in action.

Morphine is apt to make nausea worse. In some it definitely increases the vomiting. Its only good point is that is produces sleep.

Atropine probably does not increase blood pressure. It might help relieve pylorospasm. In the milder cases it might be of slight value, but in the worse cases it gives no benefit at all. It has been given by some on the presumption that seasickness is a temporary endocrine disturbance. Tincture of hyoscyamus has likewise been given with no benefit in my cases; it often makes the patient vomit due to the taste and needs to be given in capsule.

Liquors are said by Osler to help a few cases. It decidedly makes the patient worse in my experience. Cocaine by mouth was of no value. We tried the use of both cocaine and codein in solution instilled into the auditory canals. It did no good. The rationale is of course wrong, as there is no nerve connection with the labyrinth.

Benzedrine inhalers were used with hope of increasing the blood pressure and of relieving the congested heavy feeling in the nose, eyes, and forehead. It was of doubtful value and in some it tends to keep them awake which defeats our purpose to produce rest and sleep.

Proprietary remedies such as Mothersill's usually include bromides and perhaps a little chloretone. Amytal and sodium amytal have given the best results of anything used. They produce sleep and help tide the patient over the worst part of the trip until compensation in varying degrees occurs.

CONCLUSIONS

(1) Real seasickness is not psychic.

(2) Predisposing factors such as poor health, disease, improper food, drinking, loss of sleep, etc., may make the patient more susceptible

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or the seasickness worse. Constipation is reputed to have a bad influence. It is better to use low, carefully given enemas than cathartics which stir up the gastro-intestinal tract.

(3) Mild cases may be benefited by any simple remedy.

(4) A person may be subject to seasickness at one period in life and get over it eventually.

(5) The treatment that has given best results and varying degrees of relief for us before sailing is as follows:

(*a*) Chloretone grains 3 to 5 tid. for 2 days.

(*b*) Simple easily digestible foods for a few days, avoiding slimy or greasy foods and heavy pastry.

(*c*) Plenty of sleep the night before sailing; using 3 grains of sodium amytal if necessary.

(*d*) Normal bowel movements daily.

(*e*) Avoid banquets, parties, drinking bouts, etc., the night before.

(6) After the ship gets underway the keynote is rest and sleep:

(*a*) Go to bed first day or two, lying on back with face upward until acute symptoms subside; then if agreeable go up on deck.

(*b*) Liquids are important if tolerated; if not water alone may be. Solids are tolerated by a few but care must be exercised to avoid dehydration.

(*c*) Stress should not be placed on attempts to stop vomiting. The stomach is a sympathetic, weeping neighbor and being only reflex is not the primary concern. Vomiting often gives relief for a short time during which time sleep may follow. Medicines directed at the stomach do not get at the cause. If vomiting is so severe that sodium amytal is not retained, morphine by hypo or sodium amytal by vein may be necessary.

(*d*) The bowels should be regulated by low enemas.

(*e*) As food becomes tolerated, it should be simple, easily digested, and given frequently in small amounts. It may be necessary to abstain for a day or two from all things except water.

(*f*) Sodium amytal, 3 grains, should be given every 8 to 12 hours till improvement is noted. During sleep the body tends to compensate, herein lies the value of sleep and rest and why sodium amytal is so welcome. Some patients almost beg for the relief it gives.

(*g*) After improvement is noted and the patient is up and about and is beginning to eat simple foods a raw apple at night often gives valuable aid.

SUMMARY

Benefit derived from treatment varies with the individual and the ships' motion.

Given a patient who is subject to real seasickness, and weather conditions that cause a ship to roll, pitch, yaw, vibrate, and shimmy,

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I am convinced that the only real and complete cure is to sit under a big tree.

AIRSICKNESS

By Lt. Comdr. C. C. Yanquell, Medical Corps, United States Navy

The term airsickness has been loosely applied to the familiar syndrome of pallor, sweating, nausea, and vomiting which may be experienced during or following aircraft flights. A designation such as vestibular hyperstimulation might be more appropriate from the etiological side, although not as descriptive to the victims of the disturbance.

There is much evidence that airsickness is the rule rather than the exception among student aviators and passengers who fly infrequently, and, under proper provocation, it should be considered a normal reaction. The statement, so often made, that airsickness and its etiological twin, seasickness, are mostly psychic in origin is an error. Anyone who goes to sea enough will become seasick, on occasion, and the aviator who has never been airsick will be, if his memory and flying log are reasonably long. Individuals who, seemingly, are immune to these two ailments fail to interpret mild symptoms, such as headache, or aversion to tobacco, which are just as pathognomonic as the retching of the final stage.

A year's observation of students completing the primary landplane course at the Naval Air Station, Pensacola, revealed that almost 100 percent either admitted that they had suffered some of the cardinal symptoms of airsickness or actually had been treated for this condition at the field dispensary. Exact figures are not quoted, for the average person undergoing aviation training appears to think airsickness a form of physical defect, and is quite reluctant to admit any but the extreme manifestations which are noticed by his instructor. Detailed questioning is necessary to secure accurate information from mild cases, and this has not always been practicable. A small minority of students persistently denied all symptoms of airsickness, and one of these had been forced to escape from his spinning plane by means of his parachute when the ship, through no fault of its own, was permitted to enter that maneuver. It may be significant that he later on failed the course.

It should be remembered that these student aviators had been found free from middle and internal ear disease before they were permitted to fly, and that their equilibratory apparatus had been judged normal by the Barany chair and self-balancing tests. As a group they are superior, physically, to the remainder of the Navy, and markedly so, to the civilians of their age.

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The aerial maneuver which appeared to cause airsickness most readily among students was the snap roll which is a violent 360° rotation of the airplane about its horizontal axis while in level flight. The Immelmann turn was next in frequency, as might be expected, for it consists of a half roll and 180° change of direction upon the summit of a loop. The irregular bouncing about of the apparently straight flying plane in rough air was distressing to few students, although complained of bitterly by transport plane passengers.

The symptoms were less in solo acrobatics or when the student "followed through" with the instructor on the dual control stick. This inhibition of the sympathetic response, through preparation, by knowledge of the coming stimulation was ineffectual with cases of so-called airsickness with a neurotic base.

The practical application of the study of the symptoms of airsickness for the flight surgeon lies in the differentiation of the normal reaction of the student flyer from the pathological complex of the neurotic. The former individual can and will adapt himself quite perfectly to stunt flying if handled sensibly and sympathetically, but the latter may be airsick, no matter what his Barany chair tests show.

Once overcome, true airsickness appears again so seldom in the actively flying pilot that when it seems present there must be thorough search for carbon monoxide gas poisoning and many other conditions before it can be diagnosed with certainty. Eye muscle imbalance and effort syndrome can simulate the symptoms of airsickness.

The following abridged case histories are illustrative of true airsickness, and also two different but pathological conditions with similar symptoms, occurring under flying operations:

CASE REPORTS

Case 1.—Aviation cadet X reported daily for a week to the flight surgeon, during his first instructions in aerial acrobatics at Pensacola, complaining of nausea and vomiting. His symptoms disappeared shortly after landing and did not present themselves during level flight. He had no physical defects and was considered well adapted for aviation training.

This student's condition appeared rather hopeless at first, but he was continued in the course and given his stunt instruction in small and graduated doses. Eventually he became habituated to acrobatics and finished the squadron course with credit.

Case 2.—Aviation cadet Y. This student reported to the medical officer following his first instruction flight in acrobatics in the primary landplane course, complaining of vomiting and headache. He said that his first airplane flight, during his elimination training, prior to coming to Pensacola, had made him somewhat nauseated in the glides, but that he did not report it, thinking he would overcome the condition. Subsequently, every hop gave him uneasy gastric sensations which disappeared when he landed. His general physical examination showed no defects and his habits were exemplary. There was no suspicion of exhaust-gas poisoning.

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Treatment and stunt flying in mild degrees were of no avail, and he was suspended from flying and discharged from training when he began to feel nauseated while seated in the plane on the ground, or even while approaching the ship. This was apparently a neurosis.

Case 3.—Lieutenant Z, a naval aviator of 10 years' experience and considered very well adapted, aeronautically, complained of double vision, nausea, and vomiting which appeared somewhat suddenly while he was flying his light bombing plane in formation with his squadron. After these symptoms began to recur daily and forced him to leave the formation, he reported to the medical officer, who noted a marked ocular muscle imbalance and a frontal sinusitis, undoubtedly of very recent development. The officer eventually was retired because of the physical defect which could not be remedied sufficiently to make him safe for aviation and the service. This case is reported because of its superficial resemblance to airsickness.

The treatment of airsickness in the student pilot consists largely in subjecting him to the acrobatics course in a graduated scale, along with attention to his hygiene. Aside from preliminary assurance that nothing is wrong with him physically, no psychic stimulation is necessary or advisable. His habits must be corrected, if, for example he smokes excessively, missses breakfast routinely or is constipated. No drugs can be used, for the only effective ones are of a sedative nature which, obviously, are contraindicated in an occupation requiring alertness and accurate judgment.

Among aerial passengers something can be done in the way of therapy for their comfort, and the following remedies and practices have been selected, by trial, from a host of recommendations. None are completely effective in certain cases, as may be surmised from the paper vomitus container by the passenger seats of the air liners.

In the beginning, people fearing airsickness should correct constipation and its result, the "bilious" attack, the symptoms of which are nearly the same as the aerial disturbance. A few days' treatment on acidophilus milk, a glass or two with meals is excellent. Alcohol must be avoided, and the usual hang-over quite promptly makes the passenger sick in the air.

Drug treatment resolves itself into antispasmodics and sedatives. A course of calcium lactate, 15 grains tid., for a week prior to the aerial journey has been used, and the tincture of belladonna, 5 minims, is of definite value to many. However, sodium amytal, 3 grains just before embarking, appears to be the most reliable drug, if there seems to be apprehension. The bromides are nauseating in themselves, and usually soon rejected after the take-off of the plane.

Once in the air and faced with the early symptoms of airsickness the passenger may often overcome the nausea by directing his gaze away from the wings of the plane, and by staring rather fixedly at some distant terrain. Fresh air should be admitted to a cabin plane. Sips of iced ginger ale, from a handy thermos bottle produce great relief to many sufferers.

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Most of the other remedies consist of placeboes the logic of which has never appealed to the writer. The wearing of a snug abdominal binder, or cummerbund, however, has some justification.

SUMMARY

(1) True airsickness is a normal condition to which every normal person is susceptible, and which can always be overcome by habituation to flying.

(2) Supposedly intractable cases must have pathological base and should be so diagnosed.

THE USE OF OXYGEN IN BODY CAVITIES [1]

WITH ILLUSTRATIVE CASES

By Capt. William Seaman Bainbridge, Medical Corps, United States Naval Reserve, Retired

Recently, when visiting the new tuberculosis sanitarium in Rome, the Istituto Carlo Forlanini, I was shown numbers of cases where Forlanini's method of the treatment of phthisis—artificial penumothorax—was employed with excellent results. Those in charge drew my attention to what they considered a great advance in this treatment, that is, the infusion of pure oxygen into the chest cavity, after the collapsing of the lung. Better results than ever before were being obtained. It was a real gratification to the author to learn that the utilization of this treatment had been suggested by his published articles, giving his early animal experimentations and the outcome of his use of the method on the human subject. He was informed that throughout Italy and in certain other European countries the method was being successfully employed.

A few years ago a surgeon in one of the far western States of our country reported that in his treatment of certain abdominal conditions, he had been introducing pure oxygen into the cavity and had been securing excellent results. An editorial in a medical journal referring to this, heralded it as an innovation of signal value.

For the foregoing reasons and more, because of my many years' experience with the infusion of oxygen in body cavities, and because I believe it is not being used as extensively as it could be in the types of cases where much benefit would be obtained, I am again submitting a paper on the subject.

In the New York City Children's Hospital and schools, formerly situated on Randall's Island, N. Y., there were about 1,800 cases of various types of endocrinic dyscrasias. Many coming in suffered from malnutrition, and there were numbers of patients with tubercu-

[1] Read at the annual meeting American Therapeutic Society, New York City, April 2, 1938.

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lous peritonitis. One of the cases was a boy, a child of 8 years, in a desperate condition. He had fibrocystic tuberculous peritonitis with ulceration, and tuberculosis of the right testis. It was impossible to open all the partitions in the abdominal cavity and to evacuate the fluid completely, but two large compartments were opened. The patient collapsed, stopped breathing, became cyanotic and pulseless. An oxygen tank was nearby and the thought came to the operator to introduce pure oxygen into the peritoneal cavity and sew up the abdomen. This was done in 1903 and was the first case the author so treated. The effect was almost miraculous—the general condition immediately improved, a marked tonic effect was noted, pulse and respiration became normal, cyanosis disappeared. However, the case was too far advanced to permit a cure, and the patient succumbed in a few days after the oxygen had been absorbed, giving definite proof of the beneficial effects of the gas during the process of absorption.

As far as I have been able to determine by a careful study of all the literature available on the subject, this case was the first in which oxygen was introduced into the abdominal cavity for any pathology, after laparotomy, and the abdomen sutured with the gas in situ. In my experience with this form of the therapeutic use of oxygen, extending over a period of 35 years, I have noted only beneficial effects. The result obtained with this first case warranted further use of the gas and further experimentation, which was done with the aid of Dr. James T. Gwathmey, Dr. Harold D. Meeker, and other members of my staff.

It is a far cry from the "pneumatic school" of medicine founded in Rome by Athenaeus of Cilicia to our present knowledge and use of oxygen. This school of thought, which flourished about 70 to 160 A. D. believed that the "pneuma" (the world soul of the Stoics) traveled by way of the respiration to the heart, and from there was driven into the vessels and the entire body. Also ascribed to the "pneuma" were the elementary qualities of warmth, cold, moisture, and dryness—the proper functioning of the "pneuma" and its union with warmth and moisture resulting in health. Up to Harvey's day it was believed that the object of respiration was to cool the fiery heart and that the generating of vital spirits and the elimination of the smokey vapors of the heart by the pulmonary vein, were the purpose of the movements of the chest. The so-called pathetic quest for oxygen was started, and led through devious paths and in many fields, and in 1771 concurrently and quite independently, Scheele of Sweden, and Priestley of England discovered the gas. In fact, in the eighteenth century, between the years 1757 and 1775, the modern theory of respiration was completed by the discovery of the different gases in the atmosphere—carbon dioxide, hydrogen, nitrogen, and oxygen. Soon Beddoes' "Pneumatic Institute" was established

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and a century later "oxygen parlors" came into existence, but the use of oxygen for therapeutic purposes made little or no definite advance. Intermittently the gas was utilized and abandoned. But one point was definitely established—that oxygen is the only element of which a constant supply is necessary to maintain life.

Those who have experimented with oxygen, or who have utilized it in practice, have noted its beneficial effect upon the digestive system when it is regularly inhaled. It whets the appetite, stimulates the digestion, increases energy, and induces a sense of general well-being. When introduced into the pleural or peritoneal cavity its immediate effect is noted by the improved general condition of the patient, more active circulation, blood more deeply red, skin pink, with a stimulation of the mind and appetite.

The gas has been employed for many and sundry purposes, usually with good effect, but more for dyspnea than for any other condition.

In surgery, oxygen exerts a very useful influence. In a communication published in 1908 I gave a summary of my experimental work with regard to the effects of the infusion of oxygen into the abdominal cavity conducted on a large series of cats, to determine:

(1) The absorbability of oxygen.

(2) Its effect upon blood pressure, pulse, respiration, degree of anesthesia, time of recovery after anesthesia.

(3) A comparison of the results upon the above when oxygen is employed and when air is utilized.

(4) The danger point of intra-abdominal pressure as manifested by a fall in blood pressure, respiratory embarrassment, and cardiac failures.

(5) The effect of the gas upon adhesions in the abdominal cavity.

The conclusions drawn were as follows:

(1) Oxygen is completely absorbed in the abdominal cavity.

(2) It is a slight respiratory stimulant.

(3) It is a slight cardiac stimulant.

(4) It has but little effect upon blood pressure when the pressure of the gas is moderate.

(5) It tends to bring an animal quickly from deep anesthesia.

(6) It hastens the recovery of an animal after discontinuance of the anesthetic.

(7) A pressure of more than 1,500 mm. of water may cause collapse.

(8) Oxygen tends to prevent the formation of adhesions.

(9) It quickly changes a dark blood to scarlet in cases of anoxemia.

(10) It stimulates intestinal peristalsis.

(11) It is not an irritant to the peritoneum or abdominal viscera.

(12) It tends to prevent shock mechanically when, through sudden relief of intra-abdominal pressure, splanchnic venous congestion is the main factor.

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These results were such as to cause me to decide to utilize oxygen in body cavities when the condition demanded it, leaving the gas in place to be absorbed.

During this period of experiments on animals, I gave a demonstration before the Kings County Medical Society. Three cats, as nearly alike as possible as to size and weight, were secured. Dr. James T. Gwathmey gave the anesthetic. I tied off some of the vessels in the neck of the first cat, opened the abdomen, rawed the intestine for four feet, sutured the abdomen, and laid the animal in a corner. It promptly died of shock. The same procedure was followed with the second cat except that before closing the abdomen it was filled with air. In about an hour it, too, succumbed. In the third cat the procedure was repeated but oxygen was introduced into the abdomen instead of gas. I turned and continued my address to the audience. In about 10 minutes the cat came out of the anesthetic, looked around, and promptly ran out of the hall. The meeting was broken up in an effort to catch the cat!

It is of interest to record that during the Zulu War in Africa in 1879 it was the habit of the natives to carry their wounded soldiers to the high mountain peaks and expose the wounds to the free air. Extraordinarily fine results were noted. Similar results were observed in Japan, I was informed by a Japanese surgeon some 25 years ago, when after laparotomy, in cases of tuberculous peritonitis, the opened abdomen was exposed to air and sunlight for 15 or 20 minutes. Despite the fact that he did not recognize the cause for the cure, Spencer Wells reported the first case cured of tuberculous peritonitis in 1872 by the simple process of opening the abdomen.

In my published articles in 1908, 1909, 1913, 1922, and 1934, I have laid stress, and wish here to reiterate, on the importance of using as nearly pure oxygen as it is possible to obtain, for employment in body cavities. An analysis of that which I have utilized shows that it contains 94.3 percent to 97 percent oxygen; 2.37 percent to 4.4 percent nitrogen; a trace of carbon dioxide, no chlorin or nitrous gas. Many tanks of oxygen on the market are very variable as to content.

My procedure is as follows: The gas is warmed to a temperature as nearly blood heat as possible, by passing it through a rubber tube from the tank in which it is compressed into a wash bottle filled with hot water. The partially warmed gas passes from this bottle through the exit tube, which is coiled in a basin of hot water. The long exit tube is connected to a piece of sterile rubber tubing, through which the gas is introduced into the abdominal cavity. The abdominal wound is closed except at the site where the free end of the tube is placed within the abdominal cavity. One stitch is introduced above, and one below the tube, and these are tied. An interrupted stitch is placed in the peritoneum at this point, ready to be tied, and a purse-

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string suture is introduced around the tube in the peritoneum, left long, but not tied. All layers of the abdominal wall are closed, up to the skin, and the stitches tied, with the exception of those in juxtaposition to the tube. These, layer by layer, are tied after the purse-string stitch has been fastened. When the desired amount of gas has been introduced, the tube is carefully withdrawn and the purse-string stitch tied.

In the chest cavity, the fluid is slowly withdrawn through a medium sized cannula, and pure oxygen is slowly introduced by way of a small cannula, just short of the amount being utilized which would cause discomfort to the patient.

The following reports are a few from my case records:

Case 1.—J. D., I operated upon this patient, a woman, at Mr. Harold Chapple's clinic in Guy's Hospital, London. Removed 10-pound tumor. Inflated abdomen with oxygen to about the size of the removed mass. A few minutes after returning patient to her bed, was called to the ward by nurse who stated patient had stopped breathing. Found subject with cheeks and finger nails pink. Gently slapped her on the chest and she cried aloud. Gas gradually absorbed and patient made excellent recovery.

Case 2.—M. C. O., female, 53 years. Multiple uterine fibromata; right ovarian cyst. Operation November 18, 1908. Several quarts of ascitic fluid evacuated from peritoneal cavity. Large cyst of right ovary adherent to stomach and other viscera in upper abdomen. Panhysterectomy, leaving only tip of cervix. Entire mass weighed 61½ pounds. Patient's weight after operation 62½ pounds. Shock very great. Oxygen introduced into abdomen until nearly size prior to operation. Condition rapidly improved. Took about 14 days for oxygen to be completely absorbed, during which time face was flushed, lips moist and red. At end of 38 hours bowels moved without catharsis and only with low enema. No nausea or vomiting; no paralysis of gut. Recovery uneventful; 12 years later, in 1920, alive and well; then lost track of.

Case 3.—J. S. H., 13 years; male. Operation April 8, 1919. Marked condition of tuberculous peritonitis. Small intestine matted together with loose adhesions. Considerable fluid removed from abdominal cavity. Peritoneum, abdominal organs and abdominal wall covered with typical tuberculous nodules. Appendix removed. Abdomen filled with oxygen (fully distended) and then closed. Convalescence uneventful. Patient regained perfect health. Was on football team at college. Well today, 19 years after operation.

Case 4.—M. W., 59 years; female; married. Operation June 16, 1926. Large multilobular right ovarian cyst. Tapped a number of cysts with trocar. Removed mass, which weighed 47 pounds. Much degenerated tissue. Introduced pure oxygen, inflating abdomen almost to size prior to operation. Oxygen gradually absorbed. Patient in perfect health for 11 years; died in April 1937 of bronchopneumonia.

Case 5.—M. J. S., 5 years: female. Had been operated upon in March 1930 for appendicitis; 2 weeks later abdomen again opened because of pain and swelling; diagnosis of sarcoma made; life despaired of. I was called in consultation April 4, 1930. After examination of patient and slides made diagnosis of tuberculous peritonitis. Building up process instituted. Gradually improved. January 31, 1931, I removed septic tonsils, and on February 3, 1931, operated for large abdominal hernia. Found mass of adhesions between omentum and hernial sac, liver and diaphragm, gallbladder and duodenum. Tuberculous nodules in

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mesentery of small bowel and sigmoid, and down into pelvis. Abdominal adhesions broken up; herniotomy; abdomen inflated with oxygen. Excellent recovery. Periods began normally 6 years later. Today is a tall, well developed girl of 13 years in perfect health.

Case 6.—B. E. L., 30 years; female; single. Suffering from tuberculous peritonitis, cystic ovaries, and chronic appendicitis. Operated May 20, 1907; curettage, appendectomy, right oophorectomy; partial left oophorectomy. There was marked cyanosis, but this disappeared upon introduction of oxygen into peritoneal cavity; pulse immediately became stronger, respirations deeper, general condition markedly improved. Oxygen absorbed in about 48 hours. Patient continued well for some years, then developed a diabetic condition, but there was no return of the tuberculous peritonitis. In April 1932 died of coronary thrombosis.

Summarizing, it can be stated:

1. That oxygen is of value in cases of tuberculous peritonitis, particularly of the ascitic variety.
2. That it is of value in selected cases of pleurisy with effusion.
3. That it is utilized to advantage in cases of tuberculosis of lungs with artificial pneumothorax.
4. That it is of value as a tonic support and to prevent adhesions in certain cases where large abdominal tumors are removed.
5. That it is of value in lessening the number of tappings in cases of ascitis due to a cardiac, hepatic, or renal condition.
6. That it is a therapeutic treatment which exerts a highly beneficial action, and in some instances is a life-saving procedure.

Author's Bibliography

Oxygen in Medicine and Surgery. A Contribution with Report of Cases. New York State Journal of Medicine, June 1908.

The Intra-Abdominal Administration of Oxygen. A Further Contribution With Reports of Additional Cases. Annals of Surgery, March 1909.

Technic of the Intra-Abdominal Administration of Oxygen. American Journal of Surgery, October 1913.

Oxygen in the Peritoneal Cavity, with Report of Cases. American Journal of Obstetrics and Gynecology, April 1922.

The Treatment of Tuberculous Peritonitis by the Intra-Abdominal Use of Oxygen. International Journal of Medicine and Surgery, May–June 1934.

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NAVAL RESERVE

PROMOTIONS, FIRST QUARTER, 1939

Angelo Joseph Capone, 390a Broadway, Somerville, Mass., promoted to lieutenant, MC–V (G), U. S. N. R., January 7, 1939.

George W. Wagoner, 5 Polo Road, Bryn Mawr, Pa., promoted to lieutenant commander, MC–V (S), U. S. N. R., January 7, 1939.

RESIGNATIONS, FIRST QUARTER, 1939

J. S. Bumgardner, Heyburn Building, Louisville, Ky., lieutenant, MC–V (S), U. S. N. R., resignation accepted January 3, 1939.

Leonard B. Ainsworth, 351 Essex Street, Lawrence, Mass., lieutenant, junior grade, MC–V (G), U. S. N. R., resignation accepted January 24, 1939.

Overton Brooks, 608 South Dearborn Street, Chicago, Ill., lieutenant commander, MC–O, U. S. N. R., resignation accepted January 24, 1939.

Daniel J. Dolan, 420 East One Hundred and Fifty-ninth Street, New York, N. Y., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted January 24, 1939.

William S. Kiskadden, 803 Wilshire Medical Building, Los Angeles, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted January 24, 1939.

Edwin King Morgan, 52 Remsen Street, Brooklyn, N. Y., lieutenant, MC–V (S), U. S. N. R., resignation accepted January 24, 1939.

Hugh Miller, 1614 Locust Street, Philadelphia, Pa., lieutenant commander, MC–V (G), U. S. N. R., resignation accepted February 6, 1939.

Carl H. Bayha, Toledo Clinic, 2001 Collingwood Avenue, Toledo, Ohio, lieutenant, MC–V (S), U. S. N. R., resignation accepted March 4, 1939.

Benjamin H. Hager, 666 San Lorenzo, Santa Monica, Calif., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted March 4, 1939.

Daniel N. Barber, 1117 Virginia Street, East Charleston, W. Va., lieutenant commander, MC–V (S), U. S. N. R., resignation accepted March 30, 1939.

DISCHARGES, FIRST QUARTER, 1939

Eugene Orme, 1195 Bush Street, San Francisco, Calif., lieutenant commander, MC–V (S), U. S. N. R., discharged February 16, 1939.

Joseph Paul de River, 3715 West First Street, Los Angeles, Calif., lieutenant, MC–V (S), U. S. N. R., discharged March 25, 1939.

HONORARY RETIRED LIST, FIRST QUARTER, 1939

Walter Hubert Flanders, 28 Rost Street, Melrose, Mass., lieutenant commander, MC–O, U. S. N. R., transferred to the honorary retired list March 17, 1939.

TERMINATION OF COMMISSION IN RESERVE, FIRST QUARTER, 1939

Lewis S. Sims, Norfolk Naval Hospital, Portsmouth, Va., lieutenant, junior grade, MC–V (G), U. S. N. R., termination of commission March 7, 1939.

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NOTES AND COMMENTS

PROSPECTIVE STAFF CORPS LEGISLATION

Recently the Naval Affairs Committee of the House of Representatives requested the Secretary of the Navy to appoint a board representing the various staff corps of the Navy, the "engineering duty only" group and the "aviation engineering duty only" group, to prepare staff corps personnel legislation to be submitted to Congress in January 1940. This board has been appointed and will endeavor to prepare desirable staff corps legislation within the time specified.

In view of this action letters have been addressed to certain medical and dental officers, who, in their official positions, represent groups of Medical Department officer personnel, requesting them to submit by letter to the Surgeon General such suggestions and comments as they desire to make in this regard. The suggestions desired are those which are constructive in nature and which may be advantageous to the medical and dental corps insofar as attempting to obtain desirable personnel legislation for these corps is concerned.

Any officer of the medical or dental corps who desires to submit suggestions or comments on proposed legislative changes pertaining to their corps is invited to do so, by letter, addressed to the Surgeon General. Letters of this nature should be submitted in the near future in order that the Bureau may have an opportunity to thoroughly consider all such suggestions and comments as may be submitted.

THE NEW YORK ACADEMY OF MEDICINE GRADUATE FORTNIGHT

The New York Academy of Medicine will hold its Twelfth Annual Graduate Fortnight from October 23 to November 3, 1939. The purpose of the fortnight is to make a complete study and authoritative presentation of a subject of outstanding importance in the practice of medicine and surgery. All members of the medical profession are eligible for registration.

The subject of this year's fortnight is the Endocrine Glands and Their Disorders. A carefully integrated program will include clinics and clinical demonstrations at many of the hospitals of New York City, evening addresses, and appropriate exhibits. The evening sessions at the academy will be addressed by recognized authorities in their special fields, drawn from leading medical centers of the United States. The comprehensive exhibit will include books and roentgenographs; pathological and research material; and clinical and laboratory diagnostic and therapeutic methods. It is also planned to provide demonstrations of exhibits.

The subject of the fortnight will include the following:

Historical sketch of the development of endocrinology.
Physiology of anterior lobe of pituitary gland.

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Hyper and hypopituitarism.
Pituitary diencephalic syndromes.
Physiology of the ovaries.
Physiology of testes and therapeutic application of male sex hormones.
Puberty, menstruation and menopause.
Pregnancy.
Therapeutic application of female sex hormones.
Physiology of the parathyroid.
Hypo and hyper-parathyroidism.
The adrenal cortex.
The Cushing Syndrome: Neoplasms of adrenal and their clinical relations.
Overfunction of the adrenal cortex.
The adrenal medulla.
Adrenal insufficiency.
Relation of diabetes to endocrine system.
Relationship of endocrines to nervous system.
The physiology and principle inter-relations of the thyroid.
Hyperthyroidism and hypothyroidism.
Surgical treatment of hyperthyroidism and other diseases of the thyroid gland.

The New York Academy of Medicine provides this program for the fundamental purpose of medical education. Consequently all members of the medical profession are eligible for registration.

It is suggested that medical officers desiring to attend this fortnight make official request to the Bureau for authorization and credit for attendance.

METHOD FOR CHILLING PHOTOGRAPHIC SOLUTIONS

Experience has shown that the greatest difficulty is found in maintaining x-ray developer at proper temperature aboard ship, especially while operating in the Tropics. Naturally the expense involved in equipping small x-ray units with refrigerating facilities would not be a justifiable procedure.

A method reported, by Commander W. H. Perry, Medical Corps, United States Navy, and Pharmacist's Mate First Class H. H. Laramore, United States Navy, which has proved to be very satisfactory, is as follows:

> Developer is removed from the tank in quantities sufficient to fill one or two empty ice trays taken from an electric refrigerator, this solution is then replaced in the refrigerator and allowed to freeze. When the occasion arises these trays may be taken from the refrigerator and submerged in the tank of developer for such period as is necessary to bring the solution down to the desired temperature. Development may then be carried out without the usual hazard to the film which results from development at high or improper temperatures.

By this quick simple method which almost every ship may employ, developing solutions can be brought to the proper temperature without delay, expenditure of great quantities of fresh water, or dilution of the developer. Freezing of the developing solution apparently results in no chemical change which alters its action. One or two trays are kept frozen at all times ready for use.

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BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The EDITOR,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.
(For review)

DENTAL SCIENCE AND DENTAL ART, edited by *Samuel Gordon, Ph. D., National Research Council Fellow (Biological Sciences), 1926–28; Director American Dental Association Bureau of Chemistry, and Secretary of the Council on Dental Therapeutics, American Dental Association, 1928–37.* The contributors number eminent Dentists, Physicians and General Scientists. Octavo, 731 pages, illustrated with 224 engravings. Lea and Febiger, Philadelphia, 1938. Price cloth $9.50, net.

To the reviewer the great variety of subjects treated permit mention of but a few of the chapters. The results from the investigation show many findings in fields which are still open to further investigation. The content of the book is ably arranged.

Schours' two chapters: Tooth development and experimental dental histophysiology are well done. The results arrived at are backed up by clever experiments. His findings on fluorosis coincide with findings published by Department of Public Health in recent years. Under "Myths of Dentistry" he explodes the misconception "A tooth for every child," "A tooth for every endocrine" and calcium taken from the teeth. Also interesting and revolutionizing material is presented on calcium therapy.

The chapter on local anesthesia, theoretical and applied by Tainter and Moose traces the history of local anesthesia in an instructive manner touching on dentin anesthesia, topical anesthesia and injection anesthesia. Clever recordings illustrate the effects of local anesthesia on vital functions.

The last chapter in the book on statistical methods in dentistry by William M. Gafafer, D. Sc., Senior Statistician, United States Public Health Service, Washington, D. C., presents much food for thought.

SURGICAL TREATMENT OF HAND AND FOREARM INFECTIONS, by *A. C. J. Brickel, A. B., M. D., Departments of Anatomy and Surgery, Western Reserve University.* Pp. 291. Ill. 166, pl. 35, with 10 in color. The C. V. Mosby Co., St. Louis, 1939. Price $7.50.

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This book comes to the desk for review at the same time as the seventh edition of Dr. Kanavel's work on the same topic. Comparisons are inevitable, though unfortunate.

Dr. Brickel has devoted many years to research in this restricted field, and the results are seen in the beautiful plates as well as in the text. The first 67 pages are devoted to dissections of the several areas, with illustrative plates and clinical notes on each region. There follow some 30 pages of radiopaque injections of the spaces and sheaths of the hands and fingers, with 17 illustrative roentgenograms. The chapter on surgical treatment has 145 pages with about the same number of illustrations. The remaining 30 pages are devoted to minor topics, such as human bites, peripheral vascular disease, medicolegal aspects, and diabetic involvement.

His discussions are thorough, too thorough sometimes in the description of the minute details of his cases. One gets the idea that the author is predominantly a student and investigator, secondarily a practical surgeon. The book lacks those definite, dogmatic statements and instructions which are so essential and valuable a part of Dr. Kanavel's book.

On the whole, this first edition of Dr. Brickel's opus has laid a firm foundation for the authority which will accrue to its later editions.

INFECTIONS OF THE HAND, by *Allen B. Kanavel, M. D., Sc. D., Late Professor of Surgery, Northwestern University Medical School, Chicago; Attending Surgeon, Wesley Memorial and Passavant Memorial Hospitals, Chicago.* Seventh Edition, Thoroughly Revised. Pp. 490. Ill. 229, many in color. Lea and Febiger, Philadelphia. 1939. Price $6.

This seventh edition was completed just before the author's sudden and tragic death, in May 1938. It is the same guide that we have followed for years, brought up to date.

The author pays particular attention to the economic importance of hand infections, and their association with general infections, such as tonsillitis and influenza. He demonstrates, by statistics of several hundred cases, that early hospitalization of hand infections materially reduces the time lost from work on their account.

As stated in reviews of earlier editions, this book should be on the desk of every physician or surgeon who is engaged in industrial practice, or who may have to care for hand injuries or infections.

PLASTIC SURGERY, by *Arthur Joseph Barsky, M. D., D. D. S., Associate Surgeon in charge of the Department of Reconstructive Surgery, Beth Israel Hospital, New York City; Adjunct Professor of Plastic Reparative Surgery, New York Polyclinic Medical School and Hospital; Associate Plastic Surgeon to the Morrisania City Hospital, New York; Plastic Surgeon to the Beth El Hospital, Brooklyn, New York; Consulting Plastic Surgeon to the New York State Reconstruction Home, West Haverstraw, New York.* Pp. 338. Ill. 432. W. B. Saunders Company, Philadelphia. 1938. Price $5.75.

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A useful primer for the student who must pass examinations in the subject, but the practitioner will find it of very limited use as a guide.

SPINAL ANESTHESIA, by *Louis H. Maxson, A. B., M. D., Practicing specialist in anesthetics; former Chief Anesthetist, Harborview (King County) Hospital, Seattle, Wash.* Foreword by *W. Wayne Babcock, M. D., LL. D., F. A. C. S., Professor of Surgery, Temple University School of Medicine.* Pp. 367. Ill. 69. J. B. Lippincott Co., Philadelphia. 1938. Price $6.50.

Bathtubs were forbidden by law in Philadelphia; plastic surgery was outlawed by the Faculty of Medicine of Paris in 1788; John B. Murphy was so strongly opposed to spinal anesthesia that he wanted to have it prohibited by law. But all of these lines of human endeavor are flourishing today. Perhaps it is an advantage for an idea or a movement to be stoutly resisted by important people, just like a certain number of fleas are said to be good for a dog Certainly none can deny that spinal anesthesia is the method of choice today in a multitude of surgical procedures Wayne Babcock states in his foreword that his opinions have a background of 40,000 cases in which it has been used in his clinic.

For a complete and detailed study of every aspect of the subject of spinal anesthesia, this volume is the best that has come to the attention of the reviewer. One may differ from the author in some of his conclusions, but every debatable point is fully discussed, pro and contra, with Dr. Maxson's opinions. Certainly no one can accuse him of being bigoted. Detailed discussions will be found of drugs, technical considerations, complications and sequels, advantages and disadvantages, indications and contraindications. The book is highly recommended.

THE SURGERY OF ORAL AND FACIAL DISEASES AND MALFORMATIONS, by *George Van Ingen Brown, D. D. S., M. D., C. M., F. A. C. S., Emeritus Professor of Plastic Surgery, University of Wisconsin, etc.* Fourth edition, thoroughly revised. Pp. 758. Ill. 1031. Philadelphia, Lea & Febiger. 1938. Price, $10.

The fourth edition of this standard textbook is especially intended for teaching purposes, but it has added value as a reference for diagnostic data and methods of treatment. It is a reliable guide for the instruction of dental and medical students.

An indication of the wide scope of this volume is given by the chapter headings: Anesthesia, Hemorrhage, Shock, Pathological Dentition, Infectious Diseases, Diseases of the Mucous Membrane, Diseases of the Nervous System Affecting the Buccal Region, Diseases of Bone, Diseases of the Glands, Tumors, Diseases of the Maxillary Sinus, Nasal Deformities, Harelip, Principles of Plastic Surgical Restoration, Skin Grafting, Surgery of the Nose, Surgery of the External Ear, Surgery of the Neck, Rhytidectomy.

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SYNOPSIS OF DIGESTIVE DISEASES, by *John L. Kantor, Ph. D., M. D. Associate in Medicine, Columbia University; Gastroenterologist and Associate Roentgenologist, Montefiore Hospital for Chronic Diseases, New York.* 302 pages; 40 illustrations. The C. V. Mosby Co., St. Louis. 1937. Price $3.50.

This synopsis of digestive diseases presents in a simple, clear, and concise manner the essential facts concerning disorders of the digestive tract.

The book is divided into four parts, part one dealing with general considerations, classification, diagnostic methods, therapuetic methods, organic and functional constitutional inferiority, allergy and food sensitivity.

Part two deals with the individual diseases of the various divisions or parts of the digsetive system.

Part three deals with conditions due to intestinal parasites, and part four with digestive symptoms in extradigestive diseases.

The entire subject is handled in a practical, orderly, common sense manner, and for essential facts covering a large subject it is a valuable aid to the student and busy physician.

The book is excellently edited as concerns binding, paper, and print.

SYNOPSIS OF GENITOURINARY DISEASES, by *Austin I. Dodson, M. D., F. A. C. S., Richmond, Va. Professor of genitourinary surgery, Medical College of Virginia; genitourinary surgeon to the Hospital Division, Medical College of Virginia; genitourinary surgeon to Crippled Children's Hospital; urologist to St. Elizabeth's Hospital; urologist to St. Luke's Hospital and McGuire Clinic.* Second edition with 112 illustrations. Published by The C. V. Mosby Co., St. Louis. 1937. Price $3.

The author has given us an excellent summary of genito-urinary diseases. He has covered the subject well, especially, in reference to etiology, pathology, and diagnosis. Modern treatment is given, without details of operative procedures. In this second edition the most important improvements and additions are: Diet in the treatment of infections and in the control of calculus formation with a tabulation of special diets; recent advances in the treatment of cryptorchidism; neurogenic and functional diseases of the bladder; and, functional disturbances of the sexual system. It is an excellent book for the student and practitioner.

UROLOGY, by *Daniel N. Eisendrath, M. D., consulting urologist to the American Hospital, Paris, France; formerly attending urologist, Michael Reese and Cook County Hospitals; assistant professor of surgery (genito-urinary), Rush Medical College of the University of Chicago;* and by *Harry C. Rolnick, M. D., attending urologist, Michael Reese, Mount Sinai, and Cook County Hospitals, Chicago; formerly clinical professor of urology, Loyola University Medical School.* 750 black and white illustrations and 12 in color. Fourth edition, entirely revised and reset. Published by J. B. Lippincott Co., Philadelphia, Montreal, and London, 1938. Price $10.

In this, the fourth edition, many improvements in both diagnostic and therapeutic methods have been made. Excretory urography as a

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diagnostic method has been discussed in an impartial manner, to point out its advantages and drawbacks. The six chapters on gonorrhea in the male have been rewritten so as to form only two chapters—however, this subject is fully covered. Dr. Irving F. Stein has revised the chapter on gonorrhea in the female. Many new, excellent illustrations have been added to the chapters on early syphilis and venereal ulcers. The newer studies of the male sex hormones and their employment, together with that of the gonadotropic principle found in urine, in both diagnosis and treatment are included. Cystometry in the diagnosis of neurologic dysfunction of the bladder has been ably presented by Dr. Maurice Muschat. The chapter on Tumors of the Bladder has been revised so as to bring the question of treatment in line with present-day methods. The relation of injuries of the ureter to gynecological operations is fully discussed as is also an evaluation of stricture of nonoperative origin, a subject in which there has been recently a marked change in opinion as to their incidence. The chapters on Nontuberculous and Tuberculous Infections, Nephrolithiasis and Renal Tumors have been rewritten to include recent changes in viewpoints on the etiology, diagnosis, and treatment of the conditions included in these chapters. Adrenal hyperplasia and neoplasms in the field of urologic surgery, medical aspects of nephritis, urology in the female and in children have been well discussed in this edition. The last seven chapters give brief but comprehensive techniques in urological surgery.

The clarity of the text and the illustrations, as well as the thoroughness with which each subject is treated, makes this book very valuable, especially for the student and general practitioner.

LABORATORY DIAGNOSIS OF SYPHILIS, by *Harry Eagle, M. D., Passed Assistant Surgeon, United States Public Health Service, Washington, D. C.; Lecturer in Medicine, Johns Hopkins University Medical School, Baltimore, Md., formerly Assistant Professor of Bacteriology, University of Pennsylvania.* First edition. 440 pages. The C. V. Mosby Co., St. Louis, 1937. Price $5.

This is a book that is well worth consideration and study by the practicing clinician as well as by physicians doing laboratory work or interested in research problems in the serodiagnosis of syphilis.

The author considers various Wassermann technics, seven current flocculation tests including his own (which has been modified somewhat since publication of his book) and various colloidal spinal fluid tests.

Dr. Eagle covers a large field in a clear and concise style and unfolds to the reader interesting and enlightening phases of the various serological studies in vogue, with special considerations to the underlying physico-chemical mechanisms, which have not been seen elsewhere in one small volume.

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PRINCIPLES AND PRACTICE OF OBSTETRICS, by *Joseph B. DeLee, A. M., M. D., Professor of Obstetrics and Gynecology, Emeritus, University of Chicago; Consultant in Obstetrics, Chicago Lying-in Hospital and Dispensary; Consultant in Obstetrics, Chicago Maternity Center.* Seventh edition, 1,211 pages, illustrated. W. B. Saunders Co., Philadelphia. Price $12.

The latest edition of this standard text has been carefully worked over and obsolete matter omitted, new added. The author has gathered into this volume, as previously, all those clinical facts that his unusual experience has proved to him are essential to the successful practice in obstetrics. Particularly does he deplore the lack of knowledge of the natural phenomena in labor, holding this responsible for a large part of the at present high maternal and fetal mortality and morbidity. Consequently, he has given special attention to the chapters on the mechanism of labor and contracted pelvis.

The number of literature references has been increased.

There is hardly an obstetrical emergency that has not been described and its present treatment outlined.

SYNOPSIS OF GYNECOLOGY, by *Harry Sturgeon Crossen, M. D., F. A. C. S., Professor Emeritus of Clinical Gynecology, Washington University School of Medicine; Gynecologist to the Barnes Hospital, St. Louis Maternity Hospital, and St. Lukes Hospital; Consulting Gynecologist to De Paul Hospital and to Jewish Hospital; Fellow of the American Gynecological Society and of the Central Association of Obstetricians, and Gynecologists,* and *Robert James Crossen, M. D. Assistant Professor of Clinical Gynecology and Obstetrics, Washington University School of Medicine; Assistant Gynecologist and Obstetrician to the Barnes Hospital and the St. Louis Maternity Hospital; Gynecologist to St. Lukes Hospital and to De Paul Hospital; Fellow of the Central Association of Obstetricians and Gynecologists.* Second edition, 247 pages, illustrated. C. V. Mosby Co. St. Louis, Mo., 1937. Price $3.

This pocket-sized synopsis is based on the diseases of women by the same authors and reflects the marked advances in gynecology recorded in that text book. It is intended primarily as a guide for the practicing physician and those who expect to follow distant branches of the profession and who need to know gynecology in a general way. It will be useful for study at odd moments and for quick review of the leading points in gynecologic examination, diagnosis, and treatment.

A TEXTBOOK OF GYNECOLOGY, by *Arthur Hale Curtis, M. D., Professor and Chairman of the Department of Obstetrics and Gynecology, Northwestern University Medical School; Chief of the Gynecological Service, Passavant Memorial Hospital, Chicago.* Third edition, reset. 603 pages, illustrated. W. B. Saunders Co., Philadelphia, 1938. Price $6.

The third edition of Dr. Curtis' book contains the extraordinary advances of the past few years, the subject matter of the preceding edition being entirely rewritten with the addition of eight chapters. The author states in the preface, "The text is no longer essentially a record of personal experience, for the literature has been studied with

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painstaking thoroughness and this volume is intended to cover the entire field of our specialty."

The illustrations are excellent and the discussions on etiology, symptomatology, diagnosis, and treatment are to the point. The book is readable and not encyclopedic, yet it covers the subject in its entirety.

A particularly good feature is the bibliography.

TEXTBOOK OF PATHOLOGY, by *William Boyd, M. D., LL. D., M. R. C. P., Ed. F. R. C. P., London., Dipl. Psych., F. R. S. C. Professor of Pathology and Bacteriology in the University of Toronto, Toronto; Formerly Professor of Pathology in the University of Manitoba, Winnipeg, Canada.* Third edition; 1,064 pages, 459 engravings and 16 colored plates. Lea & Febiger, Philadelphia, 1938. Price $10.

The demand for three editions of this book during the past 6 years is proof of its popularity. In this edition the author continues to carry out his original premise that the text show pathology in its relation to the living patient and serve as an introduction to internal medicine and to surgery.

So much new material has been added that the book has been completely revised and many articles rewritten in the author's usual pleasing and inimitable style.

A partial résumé of the material appearing in the book for the first time includes the following: Experimental pulmonary embolism, repair in living tissue, the relation of anerobic streptococci to disease, the Shwartzman phenomenon, the Duran-Reynals phenomenon, lymphadenoid goitre, Brenner's tumor, adenolymphoma of salivary glands, and the Shope papilloma. A short section on sudden death has also been added. Forty three new engravings and eight new color plates have been added.

The classifications of the pneumonias and the anemias as well as the discussion on the viruses have been revised The descriptive outline of each organ in a state of health and the clinical sections on "The Relation of Symptoms to Lesions" are invaluable. A comprehensive list of references for additional reading is given.

This book is unreservedly recommended as a text or reference book to anyone interested in any branch or specialty of medicine or surgery.

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THE DIVISION OF PREVENTIVE MEDICINE

Commander C. S. STEPHENSON, Medical Corps, United States Navy, in charge

METAL FUMES

INJURIOUS EFFECTS AND HOW TO PREVENT THEM

By Surg. Roy R. Jones, United States Public Health Service

The inhalation of metal fumes is a common cause of illness among certain occupational groups. Without considering the local lesions of the skin and mucous membranes which may be caused by metal fumes, there are two very different systemic reactions which may result from breathing air containing particulate metal or metal compounds: (*a*) Metal fume fever, an acute, transitory, nonfatal disease causing slight or temporary disability; (*b*) systemic metal poisoning, mild, severe, or even fatal in its effect. The same occupational exposure may produce both reactions, metal fume fever developing following the worker's early exposure, chronic systemic poisoning developing later as a result of prolonged exposure.

The term "fumes" has been used interchangeably with such terms as vapors, gases, and dusts. We may consider metal fumes as solid particles generated by condensation from metal in a gaseous state. Condensation is usually accompanied by oxidation.

There are two chief physical characteristics of metal fumes which bear a direct relationship to the ease with which they may be absorbed: (*a*) The solid particles are much finer than atmospheric dust, probably averaging less than 0.5 micron in diameter; (*b*) they tend to flocculate and settle out of the air as dust. The finer the solid particles suspended in the air, the longer the time required for them to settle out. Many of the coarser dust particles in the air breathed are trapped in the upper respiratory tract, and by the ciliated cells lining the trachea and bronchi, while the finer particles may be carried to the terminal air spaces of the lungs. Here they are taken up by the phagocytic cells and are eliminated chiefly by way of the blood and lymph.

Sayers and his associates[1] found that only about 15 percent of inhaled particulate matter, such as lead dust from automobile exhaust gas, was retained in the lungs, the remainder passing out with the

[1] Sayers, R. R.; Fieldner; A. C.; Yant, W. P.; and Thomas, B. G. H.: Experimental studies on the effects of ethyl gasoline and its combustion products. U. S. Bureau of Mines, Monograph No. 2, 1927.

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exhaled air. Drinker and his associates [2] and Brown [3] made quantitative measurements of fumes retained in the lungs. They found a direct relationship between the percentage of fumes retained and the size of the particle and the density of the fumes breathed. They also showed that slow deep breathing increased the reaction resulting from inhaling zinc fumes. Such breathing should increase the percentage of particulate matter retained.

HAZARDOUS PROCESSES

For convenience we may place the more common occupational environments which are likely to afford a harmful exposure to metal fumes in three large groups:

(1) Smelting of ores and refining of metals.

(2) Employment at processes handling molten metal such as molding, cutting, and welding operations.

(3) Salvage and cleaning operations, including the burning of metals or metal covered objects, especially by means of acetylene torch or electric arc.

In the first class the ores or metals processed provide the source for the generation of fumes. Such operations are usually permanent and exposures tend to be more constant, although as a rule the greatest amount of fumes is generated during tapping operations.

Likewise, in the molding processes the molten metal is the source of metal fumes. In welding, cutting, and salvage operations, the metal fumes may originate from metal products processed, coated surfaces of the metals, fluxes used, or from the coating or core of the electrode used.

These latter operations may provide exposure to a greater variety of toxic metals, but as a general rule such exposures are to lesser concentrations. Exposure usually is less regular since the operations vary from time to time both as to extent and raw materials used.

CLINICAL PICTURE OF METAL FUME FEVER.—The clinical manifestations of metal fume fever are as follows:

> At the end of the day, or 2 to 12 hours following exposure to metal fumes, the individual notices a dryness of the throat in addition to the metallic taste which most workers commonly experience during exposure. A feeling of tightness of the chest, varying with the exposure, usually indicates the severity of chills and fever which are to follow. In mild cases the individual may not be aware of any fever and complain only of a chilly sensation, followed by sweating and general weakness. Exposure to extreme cold may hasten the onset of fever and chills, but as a rule the worker awakens from sleep with a high temperature and chills,

[2] Drinker, P.; Thomson, R. M.; and Finn, J. L.: Quantitative measurements of inhalation, retention, and exhalation of dusts and fumes by man; concentrations of 50 to 450 mg. per cubic meter, J. Indust. Hyg. **10**: 13-25, January 1928.

[3] Brown, C. E.: Studies in dust retention: factors involved in retention of inhaled dusts and fumes by man, J. Indust. Hyg. **13**: 293-313, November 1931.

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which are quite similar to the chills and fever experienced in attacks of malaria. After they have developed, nothing in the way of extra covers or hot baths appears to affect these chills. Toward the end of the attack the individual sweats profusely and is left with a feeling of marked weakness. In the majority of cases some weakness is still felt the next day.

It is commonly believed that hot baths and hot drinks of tea or lemonade may succeed in partially aborting the attacks, if taken at the first sign of respiratory difficulty, such as a dry throat or tight sensation in the chest. Drinker and his co-workers [4] by their experimental work were unable to show that even excessive "sweating" of an individual 2 to 4 hours after exposure altered the reactions in any manner.

ATMOSPHERIC CONCENTRATIONS.—Data relative to the minimum concentrations of metal fumes which will produce metal fume fever are rather limited. It is believed by some that, except in case of the supersensitive individual, metal fume fevers can be avoided by keeping atmospheric concentrations below 10 milligrams per cubic meter of air. Drinker and his associates [4] suggest 15 milligrams per cubic meter as a safe limit where workers are exposed to the fumes of zinc oxide, provided the fumes of such impurities as lead, cadmium, and arsenic are not also present in harmful amounts.

Our knowledge regarding safe limits from the viewpoint of chronic metal poisoning is likewise very meager. It has been shown that prolonged exposure to lead concentrations in the air breathed should be kept below 1.5 milligrams per 10 cubic meters of air.[5] In the study of chronic mercurialism among fur cutters [6] it was found that cases developed after prolonged exposure to atmospheric concentrations varying from 0.6 to 7.2 milligrams of mercury per 10 cubic meters of air. Less than 5 percent of those exposed to concentrations which did not exceed 2 milligrams per 10 cubic meters of air developed symptoms of chronic mercurialism, and all cases that developed under such exposure were mild. Canavan and his associates [7] reported upon a case of chronic manganese poisoning which developed following exposure to manganese dust, where the concentration in the atmosphere was from 10 to 20 milligrams per cubic meter of air, 9 to 12 percent of which was manganese.

METAL-FUME FEVER

A strict interpretation of the term **metal-fume fever** does not place it in the class of conditions termed **metal poisoning.** The reaction set up in the body is not directly attributable to the toxic metal, or

[4] Drinker, P., Thomson, R. M., and Finn, J. L.: Metal fume fever; threshold doses of zinc oxide, preventive measures, and chronic effects of repeated exposures, J. Indust. Hyg. 9: 331-345, August 1927.

[5] Lead poisoning in a storage battery plant. Public Health Bulletin No. 205, June 1933.

[6] A study of chronic mercurialism in the hatters fur-cutting industry. Public Health Bulletin No. 234.

[7] Canavan, M. M., Cobb, S., and Drinker, C. K.: Chronic manganese poisoning; report of case, with autopsy, Arch. Neurol. and Psychiat. 32: 501-512, September 1934.

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dependent upon the inherent toxicity of the metal particles inhaled. The superficial action of the finely divided metal destroys the tissues, and the absorption of these altered body proteins affects the individual much the same as typhoid inoculation or the injection of other foreign proteins.

Metal-fume fever has long been recognized as an industrial disease. Other terms commonly applied to the conditions are: **Brass-founders' ague, brass chills, zinc fever,** or **zinc chills, spelter shakes,** etc. Formerly it was thought due to the poisonous effects of zinc and zinc alloys. Various workers in the past quarter century have shown, however, that it may be produced by the fumes of metals other than zinc; notably copper, magnesium, manganese, and probably lead. Koelsch [8] in 1923 reported upon the occurrence of metal-fume fever among employees in a copper-rolling mill. Investigation showed the men to be working under conditions which caused them to breathe air containing heavy concentrations of copper dust. The symptoms resembled brass-founders' ague. In his report he quotes Kissalt [9] as showing that mercury, nickel, and probably other heavy metals when inhaled in vaporized form caused symptoms similar to those of brass-founders' ague.

Drinker and his associates [10] in 1927 reported that men experimentally exposed to fumes of magnesium developed the classical symptoms of metal-fume fever.

Examination of the blood of workers suffering from metal-fume fever shows a gradual increase in the polymorphonuclear leukocytes which begins toward the end of the attack and persists for some time after the fever has disappeared. This increase in white blood cells appears to have a direct bearing upon the degree of temporary immunity established. This probably accounts for another characteristic clinical observation. The workers are most likely to be affected after a vacation period. More cases develop after a holiday or on the first day of the week, after an absence of 1 or 2 days from exposure. The condition is found more frequently affecting new employees or old employees returning to work after a prolonged absence from exposure.

As a rule, gastro-intestinal disturbances are seldom complained of except in cases where exposure has been to fumes of substances affecting the digestive system. For instance, it is well known that zinc-coated metals contain other toxic metals as impurities. The welding and cutting of these release the toxic substances together with the

[8] Koelsch, F.: Metal-fume fever, J. Industrial Hygiene 5: 87-91, July 1923.

[9] Ueber das Giessfieber und verwandte gewerbliche Metalldampfinhalationskrankheiten. Kissalt, K. Zrschr. F. Hyg., 71: 472, 1912.

[10] Drinker, P., Thomson, R. M., and Finn, J. L.: Metal-fume fever; effects of inhaling magnesium oxide fume, J. Indust. Hyg. 9: 187-192, May 1927.

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fumes from the zinc as well as fumes from certain fluxes which are used.

We have no conclusive evidence regarding chronic effects produced by repeated exposure to zinc fumes. A study of workers in brass foundries [11] showed that the group experiencing attacks of metal-fume fever were in somewhat poorer physical condition than were those who did not develop fever and chills. Theoretically, those experiencing irregular exposures and complaining of repeated attacks of fever and chills which leave them in a generally weakened condition would, in a measure, develop lessened resistance to acute and chronic infection.

Detailed information regarding the pathology of metal fume fever is not available. A search of the literature at hand fails to show any record of death from metal fume fever, uncomplicated. The illness is of such a transitory nature that most of our knowledge regarding blood changes is the result of experimental work and isolated case reports.

In view of the fact that zinc is relatively nontoxic, and of the conclusions expressed by Drinker and Fairhall [12] regarding the hygienic position of zinc, it is difficult to show why chronic illness should result from exposures producing simple metal fume fever. It would seem, however, that in consideration of the recent work showing the role played by zinc in the treatment of diabetes with insulin, possibly some investigation should be made to determine if exposure to metal fumes capable of producing metal fume fever may not affect the endocrine system, especially in persons with some metabolic disturbances, such as potential diabetes or thyroid dysfunction.

DIFFERENTIAL DIAGNOSIS.—Metal fume fever may sometimes be overlooked, unless the physician considers occupational environment. The condition may simulate attacks of grippe or bronchitis; or, if in a malarial region it may be mistaken for a fresh attack or a relapse from a former attack of malaria. Careful study of the blood will aid in diagnosis; those suffering with grippe or bronchitis seldom show the increase in white cells usually found present in persons suffering from metal fume fever, while those with malaria usually show the organisms present in their blood. The duration of symptoms is usually less in the case of metal fume fever. However, it is not uncommon to find persistent rales upon examination of the chest several days after an attack. However, in persons with grippe or bronchitis, these rales are usually associated with a slight elevation in temperature, which are not found persisting in metal fume fever, uncomplicated. Massive exposure producing metal fume fever may be followed by attacks of

[11] Health hazards in a brass foundry. Public Health Bulletin No. 157.

[12] Drinker, C. K., Fairhall, L. T.: Zinc in relation to general and industrial hygiene. Public Health Report, 48: No. 32, August 1933.

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broncho-pneumonia, as a result of pulmonary irritation and infective organisms commonly present in the respiratory tract.

Metal particles are not the only injurious substance present in fumes generated by some industrial processes. The use of an acetylene torch in a space with poor ventilation has resulted in incomplete combustion of the gas and the liberation of carbon monoxide gas. Doig and McLaughlin[13] reported upon an illness affecting welders of galvanized metal, using an electric arc. The men complained of lung irritation so severe that their sputum was often blood-tinged. Investigation showed this to be caused by excessive concentrations of nitrous fumes generated by the processes. X-ray examination of the chests of several in this group, who had been employed for many years, showed changes thought due either to the prolonged irritation caused by nitrous fumes, or possibly to the fumes of silica inhaled. The electrodes used were silica-coated.

CHRONIC POISONING BY METAL FUMES

It is generally recognized that the most serious exposures to toxic metals in industry occur in occupations where the worker breathes air contaminated with these poisonous substances. It is true, systemic poisoning by metals may develop in an acute or subacute form, as a result of massive exposure. However, the vast majority of such cases are chronic, caused by frequent and prolonged exposure which leads to an accumulation of the toxic metal in the body. Poisons entering the body by way of the lungs, to be eliminated must be taken up by the blood and lymph. When present in the blood, they are carried to all parts of the body. Poison taken in by way of the mouth may not be absorbed but be passed out with the feces. If absorbed, it may be trapped in the liver and returned to the intestinal tract in the bile, and eliminated with the feces. Some, it is true, may be transferred by the blood to distant organs. Most heavy metals and their salts are true protoplasmic poisons. Some, such as iron and zinc, are more common constituents of body tissue. The action of these toxic metals is generally cumulative and no immunity, temporary or permanent, may be established if exposure is to sufficient concentrations.

Because of the fact that metals are usually toxic, the possibility of poisoning from inhaling fumes generated in the processing of any metal should always be given consideration. While zinc itself may be relatively nontoxic, it is seldom used in industry in a form free from toxic substances such as lead, arsenic, selenium, cadmium, and many others.

Following the initial attack of metal fume fever, because of the temporary immunity which they develop, workers may continue under

[13] Doig, A. T. and McLaughlin, A. I. G.: X-ray appearances of lungs of electric arc welders, Lancet 1: 771, 775, April 4, 1936.

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conditions which caused the attack and not suffer a recurrence. It must be borne in mind that these very conditions may afford exposure to other toxic metals which have cumulative effects and later lead to a chronic poisoning. If atmospheric concentrations of the fumes are kept below those capable of producing metal fume fever in the new worker, the chances of chronic poisoning by the toxic metals present as impurities are definitely reduced. On the other hand, however, these impurities may be present in amounts sufficient to lead to chronic illnesses later, although the concentration of fumes has never produced metal fume fever.

CLINICAL PICTURE OF CHRONIC POISONING BY METAL FUMES.—The symptoms produced by poisoning from metal fumes will vary. Some metals affect chiefly the nervous system, others the lining of the blood capillaries, while others exert most characteristic injury upon the blood-forming organs.

Generally speaking, the clinical picture of metal fume fever, regardless of the metal responsible, varies only in severity, while that of metal poisoning *per se* varies with the particular metal fume inhaled and with the degree of exposure. For example, massive doses of lead fumes inhaled may produce such acute conditions as lead encephalitis and severe gastro-intestinal complications; while continued exposure to smaller concentrations will cause such chronic changes as anemia, lead palsy, and chronic nephritis. Exposure to heavy concentrations of mercury vapor leads to acute nephritis, salivation, and diarrhea, while the more common industrial exposures to but slight concentrations will eventually produce the typical mercury tremor and psychic changes characteristic of chronic mercurialism. Strictly speaking, there are no signs or symptoms of poisoning from metals which cannot be due to other causes. For this reason diagnosis is always a matter of differential diagnosis and metal poisoning can only be established by careful consideration of all factors, including occupational history, medical history, clinical and laboratory findings. While laboratory findings are a very important factor in diagnosis, they cannot be relied upon as the sole evidence necessary.

PREVENTION OF METAL FUME POISONING

While the responsibility of controlling health hazards associated with exposure to fumes of toxic metals rests primarily upon the employer, effective elimination of such hazards can only be secured by the wholehearted cooperation of employers, employees, the State, and other regulatory inspection agencies. Three fundamentals contribute most to actual prevention. They are: Good housekeeping, supported by engineering control of hazardous processes, and intelligent medical supervision.

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GOOD HOUSEKEEPING.—We think of good housekeeping as applying to clean floors and work benches, materials, tools, and processes arranged and maintained in good order, adequate lighting, and no overcrowding of work places by men and materials. All these will do much to lessen the concentration of toxic fumes in the atmosphere, but seldom is the control of processes so effective that some fumes do not escape into the general air of the workroom. From here they may be inhaled, or may contaminate the bodies and clothes of the workers. So general workroom ventilation is a factor in good housekeeping.

The provision of adequate washing facilities is a prerequisite. Under certain conditions lockers and showers for workers are necessary for the safe operation of many processes.

As a rule sweeping and cleaning should be done after regular working hours. Not only can a more thorough job be accomplished, but what is more important, other workers will not be subjected to any increase in atmospheric contaminants occasioned by cleaning methods. If vacuum or wet methods are used, accumulated dust is more effectively and safely removed.

ENGINEERING CONTROL.—It has been found practical to exhaust locally most processes generating metal fumes so that the toxic fume is trapped at its source and does not gain entrance to the workroom atmosphere. This is done by means of hoods or enclosed processes. Special hazardous processes can usually be isolated in the plant, thereby making potential exposure of all employees unnecessary.

Both local exhaust and enclosed methods are more effective if special attention is given to general workroom ventilation. Disposal of fumes trapped by enclosed processes and local exhaust or isolation methods requires that attention be given that such wastes do not contaminate the air drawn into the workplaces by general ventilation.

MEDICAL CONTROL.—Adequate medical supervision entails special care in the placement of workers and should not be aimed at the selection of only supermen, since it is practical to make workplaces safe for the average man. Individuals with serious kidney, respiratory, or other systemic diseases should not be placed where they may be exposed even to minimum concentrations of toxic fumes. Where processes are known to be potentially hazardous an important check on the efficiency of engineering control is gained through regular periodic examination of workers. By this practice, in many instances, not only will evidence of absorption be detected before serious injury has resulted but an opportunity is afforded to correct control measures so effectively that the workers showing early signs of absorption may safely continue at their regular jobs. Routine records of illness should be kept. Any abnormal rate of absenteeism due to illness among an occupational group, regardless of the diagnosis reported,

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should call for special investigation to determine if there are any environmental conditions aggravating the primary illness.

PERSONAL PROTECTIVE EQUIPMENT.—If proper attention is given to the three fundamentals mentioned—good housekeeping, medical, and engineering control—only specific and unusual emergency exposure will call for the provision of personal protective equipment.

The masks or respirators provided workers who must necessarily be exposed to metal fumes should be of special construction and adapted to the processes and materials used. The United States Bureau of Mines [14] has, after testing, approved certain types of masks for workers exposed to specific metal fumes. No filter type of respirator capable of protection against toxic metal fumes has been submitted for approval. While two or three filter type respirators have been approved for protection against lead dust, the use of which may in a small way reduce the hazard of fumes, they cannot be relied upon for full protection. Filter type respirators approved for protection against nuisance and pneumoconiosis-producing dusts will not protect the user from toxic fumes. Several of the hose-line or positive pressure type masks have been approved, but there are certain limitations to their application which make them impractical for use in some kinds of work.

SUBSTITUTION.—In a vast majority of cases resort to substitution is an impractical method of eliminating health hazards due to metal fumes. The raw materials used usually have special application. Furthermore, substitution is often a dangerous practice, even though it is practical. Instances may be cited where the substituted product has proven equally as dangerous as the one it replaced, the only difference being that less was known at the time concerning its toxic properties.

SUMMARY AND CONCLUSIONS

Metal fume poisoning is a well recognized occupational disease.

Prevention of such illness is possible and practical.

Development of new processes will no doubt produce hazardous exposures, unless control of metal fumes generated is considered.

The responsibility for prevention rests with employers, but is only effected through whole-hearted cooperation of employees and interested agencies.

Management should consider industrial health problems along with problems of production, employment, and new developments. Industrial processes are changing rapidly and before installing new methods it is well to determine if such changes will affect working environment. All employees should be informed as to the health

[14] Yant, W. P.; List of devices for respiratory protection approved by the U. S. Bureau of Mines. Bureau of Mines Information Circular No. 6918.

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hazards which may be associated with their tasks and the measures which have been adopted for their protection. Practical and experienced employees should be asked to contribute suggestions as to how health hazards may be eliminated or minimized, just as they have been asked to cooperate in accident prevention work.

In conclusion, let us agree that prevention of metal fume poisoning should be given an important place in every industrial health program. We know much more concerning the causes, the illness itself, and means of its prevention than is the case with some other industrial diseases, and therefore we are the more responsible for elimination of such hazards as will produce metal fume poisoning.

FOOD POISONING

U. S. S. *Enterprise*

An outbreak of food poisoning occurred on board the U. S. S. *Enterprise* during shake-down cruise on September 12, 1938. A total of 83 men were treated, 4 of whom were admitted to the sick list. The first indications of illness appeared 3 to 8 hours after the noon meal, at which meal ground luncheon meat sandwiches, boiled unpeeled potatoes, stewed corn, tomato gravy, apple pie, and lemonade were served. In every case the affected individual had eaten ground meat sandwiches, the only single item on the menu eaten by all the affected men. Symptoms were spasmodic abdominal pain, a short period of vomiting, intestinal colic, loose watery stools, chills and subnormal temperatures in most cases, pallor and perspiration, frontal headache, sudden prostration in three cases, regular and rapid pulse, generally low-blood pressure, and accelerated respiration.

Blood counts made on two patients were as follows:

	E. M. 3c	*S. C. 2c*
White blood count	15, 250	24, 600
Segmented ---- percent	74	77
Bands ---- do	1	3
Lymphs ---- do	24	9
Monocytes ---- do	1	10
Eosinophiles ---- do		1

Blood serum from the four men who were on the sick list was sent to the Naval Medical School for examination. One man was reported negative. The other three men had identical reports as follows: Agglutination test—*S. enteritidis*, negative; *S. morgani*, two plus 1: 20; *S. dysenteriae*, negative.

Sandwiches were prepared from luncheon meat purchased by the U. S. S. *Enterprise* in Rio de Janeiro, Brazil. This meat resembled the luncheon meat used generally in the Navy, except that it was packed in 20-pound boxes lined with paper and not enclosed in a sausage

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casing. The other ingredients of the sandwich filler were mayonnaise and chopped sour pickle.

The meat used in preparing the sandwiches was taken from cold storage at approximately 4 p. m., September 11. It was solidly frozen in the containers at the time of breakout and sent to ship's butcher shop. The partially frozen meat was cooked from 5:30 to 7:50 a. m., September 12 and ground in meat grinder until 8:30 a. m. Three thousand sandwiches were made between 9 a. m. and 11 a. m.

Due to battle drills it was necessary to grind the meat early before current was cut off in order to prepare sandwiches for noon meal. It should be noted that the ship was cruising in tropical waters at this time and temperatures in the galley were necessarily very high

Sandwiches prepared from identical ingredients were served 2 days prior to this outbreak of food poisoning, with no resulting ill effect. The only difference between the method of preparation of the sandwich filler on the 2 days was the elapsed time between the cooking and grinding and the serving of the sandwiches—1½ hours on September 10 and 3½ to 4 hours on September 12. The elapsed time between preparation and serving, while not excessive under ordinary circumstances, was sufficient under the active incubator conditions prevailing at the time to permit dangerous multiplication of organisms of the enteritidis group.

All the suspected food remaining after the meal had been thrown over the side before patients appeared at the sick bay. It was therefore impossible to obtain samples for bacteriological examination.

U. S. S. *Chandler*

At the time of the outbreak of food poisoning, about 2:30 p. m., the personnel of the ship were on a liberty status, in consequence of which, some were at their homes and others were in the city of San Diego. About 12 of the men affected remained on board. During the morning, previous to the hour of the outbreak, these men were engaged in ship's work.

The food, eaten under usual circumstances and suspected of containing the causative agent of the poisoning, was that comprising the noon-day meal on December 16, 1938, which consisted of puree of lima beans, fresh shrimp salad, au gratin potatoes, stewed tomatoes, ice cream, bread, butter, and coffee.

Evidence apparently incriminating shrimp salad, the main constituent of the noon-day meal, is as follows:

(1) Nearly all persons who ate the shrimp became ill.

(2) Persons not partaking of the shrimp salad did not become ill.

(3) Several persons took a second helping and in most instances these cases were more severe than the others.

First indications of illness appeared 3 to 6 hours after the noon meal, this was the incubation period almost without exception. A

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few of the men stated they ate a small amount of the shrimp salad without any ill effect. Prior to the onset of gastro-intestinal symptoms these individuals enjoyed good health. The outbreak, therefore, could not be due to a relapse or recurrence of any other previous disorder. The onset was violent. The first indication of illness was a mild cramp-like pain in abdomen, followed soon with violent abdominal cramps, malaise, weakness, severe and frequent vomiting and distressing diarrhoea. At first the vomitus consisted of undigested food and large quantities of watery liquid with no evidence of blood. Within a short time, the vomitus decreased in amount and in several cases it contained traces of blood. Following this, retching became violent, subsiding considerably after emesis, but the nausea continued for 2 to 4 hours. In a few of these cases the temperatures and pulse rates were slightly elevated, but in most cases the temperatures ranged from 96° to 98°. All temperatures returned to normal as the symptoms subsided. Three cases were admitted to the naval hospital, San Diego, Calif., from their homes with diagnosis of gastro-enteritis, acute. This diagnosis was established by the officer of the day, at the naval hospital. Pertinent laboratory and clinical findings were recorded in these cases as follows:

(1) Blood counts and urinalyses were normal.
(2) Stool examinations for blood were negative.
(3) Blood pressures were moderately lowered.
(4) Gastric analyses were positive for occult blood.

The shrimp had been brought aboard on the morning of December 15, 1938, inspected, cooked at once, and placed on top of an air intake in the port passageway, directly over a boiler where the temperature was high, and through an oversight were allowed to remain there until noon of December 16, 1938, when they were served. Practically all the men who ate the shrimp salad became ill. Those who ate all the other foods served and no shrimp salad did not become ill. It is probable that the air current at the intake provided unusual opportunity for the induction of infecting organisms.

No specimen of the shrimp remained for analysis and culture. Gastric analyses in the cases of the men admitted to the hospital contributed no positive information.

Conclusions drawn from consideration of all the facts obtainable are as follows:

(1) Diagnosis of "food poisoning" in the cases of these men is justified.

(2) The cause of the outbreak is ascribed to infected food, i. e., shrimp salad, eaten at the noonday meal of December 16, 1938.

(3) The causes of the contamination were improper care of the cooked shrimp and delay in serving.

(4) No evidence was found to indicate that the poison was chemical, on the contrary all evidence indicated bacterial contamination.

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STATISTICS

HEALTH OF THE NAVY

The routine coding work of the statistical section of the division of preventive medicine has been delayed by the installation of new machinery. For this reason it has not been possible to prepare for publication in this issue the usual statistical summary of the health of the Navy.

Monthly reports of communicable diseases received in the Bureau recorded the following incidence of disease:

Common infectious diseases of the respiratory type.—During the fourth quarter, 1,202 cases of the common infectious diseases of the respiratory type were reported from shore stations in the United States, 122 from shore stations outside the continental limits of the United States, and 1,324 cases from forces afloat. Catarrhal fever was responsible for 1,943 of the 2,648 total admissions for these diseases.

Ships and shore stations recording the greatest number of admissions are shown in the following tabulation:

	October	November	December	Total
Naval Academy (midshipmen)	56	89	51	196
Naval training station, Norfolk, Va.	61	62	68	191
Naval training station, Newport, R. I.	35	50	77	162
Marine Corps base, San Diego, Calif.	47	29	24	100
Marine barracks, Quantico, Va.	24	18	50	92
Naval air station, Pensacola, Fla.	16	13	19	48
U. S. S. *Saratoga* (fleet air detachment)	21	11	13	45
U. S. S. *Enterprise*	19	8	13	40

A fatal case of influenza was reported by the naval recruiting station, Houston, Tex. A chief yeoman was absent from work 1 day with influenza. Five days later, following a convulsive attack, he was sent to a civilian hospital; temperature about 100° and white count slightly elevated. The following day the patient showed evidence of pneumonic process over bases of both lungs. Large doses of sedatives were given but convulsions increased in intensity and number and the patient died on October 21, five days after admission to hospital. The contributory cause of death was recorded as lobar pneumonia.

Four cases of chickenpox were reported for the quarter: In December, 2 from the 4th Marines, Shanghai, China; 1 from the Marine Corps Base, San Diego, Calif.; and 1 from the U. S. S. *Augusta.*

Scarlet fever occurred during the quarter as follows: One case on the U. S. S. *Elliot* in November; and 1 case each on the U. S. S. *Maryland* and the U. S. S. *Enterprise* in December.

An electrician's mate, 3rd class, attached to the U. S. S. *Augusta,* was admitted to the sick list with diphtheria. Broncho-pneumonia developed on September 28 and he was transferred to the German Hospital, Tsingtao, China. Death occurred on November 3, as a result of primary diphtheria and secondary broncho-pneumonia,

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which was further complicated by an edema of the lungs and paralysis of the muscles of deglutition.

Asiatic cholera was recorded as the cause of one death. A chief torpedoman, embarking into a Chinese taxi, missed his footing and fell into the bay on October 22. Artificial respiration was required and patient did not recover consciousness until 3½ hours later. Symptoms of cholera developed 2 days later and he was admitted to the Royal Naval Hospital, Hongkong, B. C. C. Apparently well on the road to recovery, he suffered a relapse on the evening of November 1 and died of toxemia and heart strain.

A private, United States Marine Corps, 24 years of age, with 1 year and 7 months' service, developed a mild case of typhus fever on November 5, the probable place of infection being reported as Peiping, China, source of infection unknown. He was admitted with a temperature of 100.4° and a rash which had been present about 24 hours. Temperature ranged from 100° to 103.6° and there was headache and some mental confusion and retardation for a period of 8 days. Convalescence was complete on November 20. No complications developed.

A hospital apprentice, second class, while en route from San Diego, Calif., to Norfolk, Va., was admitted to Providence Hospital, Sandusky, Ohio, on November 5. Patient was in convulsions and rapidly became unconscious. A tentative diagnosis of cerebrospinal fever was later confirmed by culture of spinal fluid. Patient became progressively worse and died on November 9.

A severe case of typhoid fever (a fireman, third class, 28 years of age, with 3 years, 4 months' service) was admitted to the sick list on board the U. S. S. *Chaumont*, on November 3, 1938, and transferred to the regimental hospital, Fourth Marines, Shanghai, China. Diagnosis was based upon the following clinical evidence: Continuous fever with slight daily remissions, dull headache, anorexia, general malaise, marked borborygmi and flatulence. Abdomen distended and patient complained of pain on palpation. Patient delirious, pulse comparatively slow for this fever. Intestinal hemorrhage. One course of straight typhoid vaccine was completed in August 1935.

A hospital apprentice, first class, 22 years of age, with 2 years and 7 months' service, was admitted to the sick list on the U. S. S. *Relief* on November 2 with typhoid fever. The patient was in transit on the U. S. S. *Neches* from October 15 to October 28. Probable place of infection was Pearl Harbor, Hawaii. Clinical evidence for basis of diagnosis was persistent dull headache, anorexia, continued fever, leukopenia, palpable spleen, and slow pulse rate. There was no evidence of previous typhoid or paratyphoid infection. A course of straight typhoid vaccine was completed in April 1936. The diagnosis in this case was changed to concurrent amebiasis on December 1.

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DEATHS

During the fourth quarter ending Dec. 31, 1938

Cause		Navy			Marine Corps		Nurse Corps	Total
Principal	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		10,198	2,305	107,205	1,359	17,500	438	139,005
Disease								
Anemia, splenic	Pneumonia, broncho			1				1
Appendicitis, acute	do	1						1
Do	Peritonitis, general, acute.					1		1
Carcinoma, kidney and liver.	None			1				1
Cerebrospinal fever	do			1				1
Cholera, Asiatic	do			1				1
Coronary heart disease, arteriosclerotic.	do	1				1		2
Diphtheria	Pneumonia, broncho			1				1
Diverticulum, sigmoid	Peritonitis, general, acute.	1						1
Embolism, cerebral	Myocarditis, chronic			1				1
Influenza	Pneumonia, lobar			1				1
Myocarditis, acute	None	1						1
Pansinusitis	Abscess, brain			1				1
Pneumonia, broncho	None			1				1
Pneumonia, lobar	do			1		2		3
Do	Septicemia			1				1
Septic sore throat	Pneumonia, broncho			1				1
Thrombosis, cavernous sinus.	Furunculosis			1				1
Thrombosis, coronary, artery.	None	3		4				7
Tuberculosis, pulmonary, chronic, active.	do	1						1
Do	Hemorrhage, pulmonary.			1				1
Do	Tuberculosis, meninges.			1				1
Tumor, benign, mixed, brain (cystic).	Hemorrhage, intracranial.			1				1
Tumor, malignant, mixed, stomach (adenocarcinoma).	None					1		1
Tumor, malignant, mixed, multiple (melanoma).	do			1				1
Total for disease		8		21		5		34
Injuries and poisonings								
Burn, multiple	None	1						1
Crush, chest	do			1				1
Drowning	do	1		10		1		12
Do	Alcoholism, acute			1				1
Do	Intracranial injury	1						1
Fracture, compound, skull	None			3				3
Fracture, simple, skull	Intracranial injury			1		1		2
Intracranial injury	None			2				2
Do	Pneumonia, broncho					1		1
Injuries, multiple, extreme	None	5		12		1		18
Strangulation, neck (rope)	do			1				1
Wound, gunshot, head	do	1		3				4
Do	Psychosis, unclassified.	1						1
Poisoning, carbon monoxide, acute.	None			2				2
Poisoning, potassium cyanide, acute.	do			1				1
Total for injuries and poisonings.		10		37		4		51
Grand total		18		58		9		85
Annual death per 1,000:								
All causes		7.06		2.16		2.06		2.45
Disease only		3.14		.78		1.14		.98
Drowning		.78		.41		.23		.40
Poisonings				.11				.09
Other injuries		3.14		.86		.69		.98

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MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

Statistics for the fourth quarter ending December 31, 1938

The following statistics were taken from sanitary reports submitted by naval training stations:

October, November, and December 1938	Naval training station			
	Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,265	681	690	486
Recruits appearing before board of medical survey	24	0	3	(1)
Recruits recommended for discharge from the service	24	0	3	(1)
Recruits discharged by reason of medical survey	26	0	1	(1)
Recruits held over pending further observation	2	0	(1)	(1)
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	4	(1)	14

[1] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or disease causing the surveys were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys
Absence, acquired, teeth	1
Anomaly of form, sacrum	1
Arthritis, chronic	1
Asthma	6
Astigmatism	1
Bronchitis, chronic	2
Calculus, right kidney	1
Cicatrix, skin	1
Constitutional psychopathic inferiority, without psychosis	2
Constitutional psychopathic state, emotional instability	4
Deafness, bilateral	1
Deformity, acquired, left foot	1
Dementia praecox	1
Effort syndrome	1
Enuresis	2
Epilepsy	4
Epilepsy, Jacksonian	1
Flat foot	14
Gonococcus infection, urethra	6
Hernia, epigastric	1
Hernia, inguinal	6
Intracranial injury	2
Malocclusion, teeth	4
Myopia	1
Myositis, chronic	1
Narcolepsy	1
Nephritis, chronic	1
Neurosis, intestinal	1
Otitis, media, chronic	3
Pes cavus	1
Psoriasis	1
Psychoneurosis, hysteria	6
Psychoneurosis, psychasthenia	1
Psychoneurosis, neurasthenia	4
Psychoneurosis, unclassified	1
Psychosis, manic depressive	1
Pyorrhea alveolaris	2
Sinusitis, ethmoidal	1
Strabismus	1
Syphilis	2
Trichophytosis	3
Tuberculosis, pulmonary, chronic, active, moderately advanced	1
Ulcer, duodenum	1
Valvular heart disease, mitral insufficiency	2
Valvular heart disease, mitral stenosis	1

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VOL. XXXVII OCTOBER 1939 NO. 4

UNITED STATES NAVAL MEDICAL BULLETIN

FOR THE INFORMATION OF
THE MEDICAL DEPARTMENT OF THE NAVY

DIVISION OF PUBLICATIONS
THE BUREAU OF MEDICINE AND SURGERY

THE MISSION OF THE MEDICAL DEPARTMENT OF THE NAVY

TO KEEP AS MANY MEN AT AS MANY GUNS AS
MANY DAYS AS POSSIBLE

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NAVY DEPARTMENT,
Washington, March 20, 1907.

This UNITED STATES NAVAL MEDICAL BULLETIN is published by direction of the Department for the timely information of the Medical and Hospital Corps of the Navy.

TRUMAN H. NEWBERRY,
Acting Secretary.

Owing to exhaustion of certain numbers of the BULLETIN and the frequent demands from libraries, etc., for copies to complete their files, the return of any of the following issues will be greatly appreciated:

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Volume X, 1916, No. 2.
Volume XI, 1917, No. 3.
Volume XII, 1918, Nos. 1 and 3.
Volume XXIV, 1926, Nos. 1 and 4.
Volume XXV, 1927, No. 1.
Volume XXVII, 1929, Nos. 3 and 4.
Volume XXVIII, 1930, No. 3.
Volume XXXIV, 1936, Nos. 1, 2, and 4.
Volume XXXV, 1937, No. 1.
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PREFACE

THE UNITED STATES NAVAL MEDICAL BULLETIN was first issued in April 1907 as a means for supplying medical officers of the United States Navy with information regarding the advances which are continually being made in the medical sciences, and as a medium for the publication of accounts of special researches, observations, or experiences of individual medical officers.

It is the aim of the Bureau of Medicine and Surgery to furnish in each issue special articles relating to naval medicine, descriptions of suggested devices, clinical notes on interesting cases, editorial comment on current medical literature of special professional interest to Medical Department personnel, and reports from various sources, notes, and comments on topics of professional interest.

The Bureau extends an invitation to all medical and dental officers to prepare and forward, with a view to publication, contributions on subjects of professional interest.

In order that each service contributor may receive due credit for his efforts in preparing matter for the BULLETIN of distinct originality and special merit, the Suregon General of the Navy will send a letter of appreciation to authors of papers of outstanding merit.

The Bureau does not necessarily undertake to endorse views or opinions which may be expressed in the pages of this publication.

ROSS T. MCINTIRE,
Surgeon General, United States Navy.

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NOTICE TO CONTRIBUTORS

Contributions to the BULLETIN should be typewritten, double spaced, on plain paper, and should have wide margins. Fasteners which will not tear the paper when removed should be used. Nothing should be written in the manuscript which is not intended for publication. For example, addresses, dates, etc., not a part of the article, require deletion by the editor. The BULLETIN endeavors to follow a uniform style in heading and captions, and the editor can be spared much time and trouble, and unnecessary changes in manuscript can be obviated if authors will follow in these particulars the practice of recent issues.

The greatest accuracy and fullness should be employed in all citations, as it has sometimes been necessary to decline articles otherwise desirable because it was impossible for the editor to understand or verify references, quotations, etc. The frequency of gross errors in orthography in many contributions is conclusive evidence that authors often fail to read over their manuscripts after they have been typewritten.

Contributions must be received at least 3 months prior to the date of the issue for which they are intended.

The editor is not responsible for the safe return of manuscripts and pictures. All materials supplied for illustrations, if not original, should be accompanied by reference to the source and a statement as to whether or not reproduction has been authorized.

The BULLETIN intends to print only original articles, translations, in whole or in part, reviews, and reports and notices of Government or departmental activities, official announcements, etc. All original contributions are accepted on the assumption that they have not appeared previously and are not to be reprinted elsewhere without an understanding to that effect and that editorial privilege is granted to this Bureau in preparing all material submitted for publication.

EBEN E. SMITH, *Editor*,
Commander, Medical Corps, United States Navy.

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U. S. NAVAL MEDICAL BULLETIN

VOL. XXXVII OCTOBER 1939 No. 4

SPECIAL ARTICLES

LAMINECTOMY FOR LOW BACK PAIN

WITH CASE REPORTS[1]

By Lieutenant Commander Arthur P. Morton, Medical Corps, United States Navy

Low back pain is so common a symptom and may be due to such a great variety of causes that it should be of interest in a general way to all physicians and more especially to those in certain specialties because of more intimate personal experiences. Barker a few years ago made the statement that, "There is perhaps no other common symptom that may result from pathological disturbances in such a wide field." Goldthwait remarked that, "It is probably the most common symptom for which medical relief is sought." It is apparent, therefore, that so large a subject cannot be covered here. This being the case, remarks will be limited to conditions which respond to laminectomy and conditions represented in the cases to be presented for consideration.

Kocher has been accredited with being the first to report intervertebral disk injury in 1896. Goldthwait's paper in 1905, concerning the relation of the relaxation of the sacro-iliac joints to instability of the back with the production of pain, and in 1911 he was the first to suggest that injuries of the intervertebral disks might be a frequent cause of so-called lumbago and sciatica. The surgical removal of chondromas of the intervertebral disk pressing on the spinal cord or nerve roots to produce low back pain has been described by various neurosurgeons, among them Adson (1925), Dandy (1929), Elsberg (1931), and Alpers, Grant, and Yaskin (1933). The earliest report found on enlarged ligamentum flavum as a cause of back symptoms was that of Elsberg in 1913, and he also wrote briefly of two more cases in 1916. Towne and Reichert reported two cases without antecedent trauma in 1931.

Peet and Echols reported 2 cases of herniation of the nucleus pulposus in 1934 and Mixter and Barr reported 19 cases and concluded that the lesions were not chondromas, that disk lesions were far more common than neoplasms, and that these cartilage herniations were not an uncommon cause of low back symptoms. Mixter and

[1] From naval hospital, San Diego, Calif.

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Ayers gave Barr credit for suggesting that the propulsed disks were the same as Schmorl's nodules. Other more recent reports on ruptured intervertebral disks were by Hampton and Robinson in 1936, Love 1937, Barr, Hampton, and Mixter 1937. In 1936 Abbott reported a case of enlarged ligamentum flavum with recovery following operation and the same year Hampton and Robinson mentioned a case in writing on a ruptured intervertebral disk. Spurling, Mayfield, and Rogers reported seven cases of enlarged ligamentum flavum with relief of symptoms following laminectomy in 1937.

Although lesions of the intervertebral disks and enlarged ligamenta flava were first described years ago it has only been during the past few years that these conditions have been considered as rather common causes of low back pain. The history and symptoms of patients with enlarged ligamenta flava and rupture with dislocation of a portion of an intervertebral disk are essentially the same, and clinically differentiation between the two conditions is extremely difficult or impossible. These syndromes cannot, in many instances, be differentiated clinically from lumbosacral or sacro-iliac affections, and a careful study is always required before a diagnosis can be reached.

A history of trauma, which is usually of relative slight degree, is common, but it will be recalled that cases have been reported in which this history was absent. The most frequent trauma is produced by lifting, in association with flexion and torsion of the spine, or possibly a fall on the back or buttocks. The patient frequently describes a "snapping" or "catching" sensation in the spine followed by low back pain, and later radiation of the pain over the sciatic nerve distribution into the thigh, the leg, and the foot. The interval between the onset of pain in the back and the radiation into the leg varies from a few hours to several months. The pain is usually severe and disabling. Associated with the pain, sensory disturbances and motor weakness in the involved extremity may be present. The symptoms in most instances are unilateral, but they may be bilateral if the spinal canal is sufficiently encroached upon. Almost always weight bearing aggravates the symptoms, and rest in bed may afford some degree of temporary relief.

Objectively, some degree of scoliosis with a list to the unaffected side may be present. There may also be general restriction of back movements and limitation of straight-leg raising and Kernig's manipulations on the involved side. Local tenderness which is not often severe may be found. Motor weakness of some degree is a common finding, and the tibialis anticus is frequently the affected muscle. Decreased or absent Achilles tendon reflex on the side of the lesion is rather a constant finding. Sensory disturbances of varying degrees are also common.

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A positive diagnosis of ligamentous or disk affections can seldom be made from a clinical study alone. As an adjunct to such a study a spinal puncture followed by the removal of spinal fluid for examination and then a Queckenstedt test may give additional information. After this lipiodol or air is injected into the dural canal to be followed by roentgenograms. The spinal fluid removed is examined for total protein and where this ranges above 50 mgm. per 100 cc. it is suggestive of an intraspinal pathological process, but that this is not constant in all cases must be remembered. The protein increase at one time considered in the light of spinal cord compression has now been demonstrated to be due to nerve root irritation.

A study of the anatomy in the lower thoracic and lumbar regions will reveal that the spinal column is most mobile between the tenth thoracic and first sacral segments. For this reason this is also the area most likely to be injured in all types of accidents. It will be recalled that the supraspinal ligament, which is a strong fibrous cord, extends from the seventh cervical vertebra to the sacrum and connects the apices of the spinous processes. This ligament is larger and stronger in the lumbar than in the thoracic region. The interspinal ligaments are thin membranes which connect adjoining spinous processes and extend from the root to the apex of each process. Other important spinal ligaments are the anterior longitudinal ligament which is a broad fibrous band which extends along the anterior surfaces of the bodies of the vertebrae from the axis to the sacrum with the broader and thicker part of the ligament below, and the posterior longitudinal ligament which is similar to the anterior ligament in structure and length but extends along the posterior surfaces of the bodies of the vertebrae and is within the vertebral canal. Another important ligament which will be considered more at length later is the ligamentum flavum. There is also the small thin capsular ligament of less importance.

The bony structure of the lumbar segment consists of the body of the vertebra and directed backward from the body on each side is the strong pedicle which in turn is continuous with the lamina running still further backward and toward the midline to meet the lamina from the opposite side of the vertebra. The two laminae join together to complete the neural arch and continue still further posteriorly as the spinous process. The superior and inferior articular processes, with the corresponding articular facets at the upper and lower ends of the respective processes, project respectively upward and downward from the junction of the pedicle and the lamina. The transverse process varies somewhat with the vertebra from which it comes as to size, shape, and position. In general, however, it may be said it arises from approximately the junction of the pedicle and the lamina and extends laterally and somewhat posteriorly. Other smaller

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and less important named processes are the mammillary and the accessory processes.

Now to return to structures with which we are primarily concerned in this discussion, namely the ligamenta flava and the intervertebral discs. From the position of the ligamenta flava it will be readily seen that even a moderate enlargement may cause compression of the nerve roots or the neural canal. The ligamenta flava arise from the posterior and superior margins of each lamina below, pass upward beneath the lamina immediately above to enter the neural canal and be attached to the deep surface and interior border above. They fuse in the midline and laterally have expansions which extend well down toward the anterolateral aspects of the neural canal and form the posterior margins of the intervertebral foramina. The ligaments therefore lie in close association with the articular facets in the neural canal and, to some extent, form a capsular covering or ligament for the articulations. Directly below each ligamentum flavum lies the intervertebral disk, and the very narrow space between them serves as a foramen through which the nerve root after it emerges from the dural canal leaves the triangular shaped bony canal. Any increase in the size of the ligament, or a posterior displacement of the disk, or the combination of the two, tends to compress the nerve root at this point. The ligament may be enlarged unilaterally or bilaterally. In most cases this results from injury and scar tissue formation. The normal ligamenta flava are composed entirely of yellow elastic tissue which grossly shows considerable elasticity. It seems most likely that rupture of some of the elastic fibers occurs at the time of injury to allow some degree of expansion. Later as repair takes place, scar tissue is formed with further enlargement of the ligaments and the increased likelihood of nerve root compression. Histopathological examination of ligaments after surgical removal can demonstrate scar tissue and degenerative changes in the yellow elastic ligaments.

The intervertebral disks are fractured with displacement more often than is probably thought to be the case although this is a less common cause of low back pain than enlarged ligamenta flava. The normal disk according to Schmorl is composed of a central soft pulpy substance called the nucleus pulposus which is the remains of the notochord. A fibrous tissue and fibrocartilage area surround the nucleus forming what is called the annulus fibrosus. Two thin plates of hyaline cartilage separate the disk from the bones above and below. One case in this series showed a definite posterior displacement of the disk at operation and one case showed a nucleus pulposus lying free in the tissues as a lamina was removed. The other cases showed hypertrophied ligamenta flava, or fractured articular facets, one or both.

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Treatment for enlarged ligamenta flava consists of laminectomy and a wide lateral removal of the ligaments in order to free the nerve roots from compression. As the lamina is removed, the ligament is seen immediately beneath it, and if there is generalized enlargement, the constriction of the dural sac is often very marked. The normal ligaments in the lumbar region are about 2 to 3 millimeters in thickness, but they have been reported as much as 1 centimeter in thickness. Most of the ligaments are not adherent to the dura but sometimes they are quite adherent. A thorough examination should always be made at operation in these cases to determine the presence of an associated dislocation of an intervertebral disk as any undue prominence of the disk serves to decrease the size of the passage for the nerve root, so that even a moderate enlargement of the ligament would compress the root against it. If the dislocation is sufficient to compress a nerve root it should of course be removed and this is also true of a nucleus pulposus when found.

Usually the laminae are removed by rongeurs and the ligamenta flava are often removed with the bone. This being the case care should be exercised not to overlook any enlargement of the ligaments and to feel that no lesion had been present to explain a stenosis shown on the roentgenogram after injection of lipiodol or air. Nevertheless symptoms may be relieved after operation because of the decompressive effect of the laminectomy and the simultaneous removal of an unsuspectedly enlarged ligamentum flavum.

There have been numerous classifications of conditions which give the cardinal symptom of low back pain. It at once becomes apparent that a symptom produced by so many different basic conditions offers a great variety of possibilities in arriving at a classification. In order to enumerate the present day conception of the more common causes of low back pain and to fit this series of cases into the affection as a whole the following classification is offered:

(1) Cartilaginous, ligamentous and muscular injuries of the normal lumbar spine and pelvis.

(2) Bony anomalies of the low back.

(3) Acquired skeletal lesions.

(4) Visceral lesions producing symptomatic low back pain.

Many cases of low back pain fall within the first group. The injury is either the result of more or less violent trauma or of continued muscular strain of postural or occupational type. In many cases the lesion present is a tear or sprain of a ligament in the lumbar and pelvic regions of more or less marked degree, and with an associated muscle injury. Hemorrhage and organization after a ligamentous injury may lead to loss of normal resiliency and strength. Eventually the ligaments may be chronically relaxed and therefore predispose the joint to further injury or the damaged ligaments may be

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replaced by scar formation with much thickening so as to produce pressure on nearby important structures. In other cases the injury may involve the intervertebral disks or overstretching of muscles and tearing their attachments. In recent years it has become a recognized fact that rupture of intervertebral disks with displacement of the outer fibrous portion or the nucleus pulposus is a common cause of the low back syndrome. On the other hand muscle injury has long been considered a cause of low back pain and to it no doubt have been attributed symptoms actually due to other causes.

The most common site of strains or ligamentous injury involve the lumbosacral, sacro-iliac, and intervertebral joints. Where the intervertebral joints are involved it produces enlargement of the ligamenta flava and the resulting persistent low back pain. Lumbosacral and sacro-iliac affections produce similar symptoms. Other spinal ligaments may be injured to be sure but are not so likely to cause the persistent low back syndrome as those just mentioned.

Under the second head are the bony anomalies. In routine roentgenographic examinations bony anomalies will not infrequently be found. These may be present without symptoms so the relation of symptoms to an anomaly must be correctly interpreted. The point that the anomaly of the bony structure of the lower back renders it less stable than normally and more liable to ligamentous and muscular injuries must always be remembered. The most frequent bony anomalies of the low back are elongated transverse processes of the fifth lumbar segment, defective neural arches, variations of the lumbosacral angle, variations of the articular facets, spondylolisthesis and constitutional variations as seen in cases of poor general development and faulty posture.

In the third group are acquired skeletal lesions due to chronic arthritis, neoplasms, low-grade infections, vertebral fractures, and postural stresses associated with conditions such as flat feet.

The fourth group is comprised of visceral lesions producing symptomatic low back pain. Under this head are a wide variety of visceral diseases and the pain although localized over a particular bone or joint by the patient, is entirely of referred type and not associated with lesions of the osteo-articular structures. This type of referred pain is particularly common in gastro-intestinal, urological and gynecological diseases but other diseases which may also produce similar pains are central nervous system conditions such as tabes, meningitis, and lateral sclerosis to name only a few, and sciatic neuritis. In some cases generalized infectious diseases such as typhoid fever, influenza, and septicemia are accompanied by low back pain.

All cases in this series had persistent low back pain which radiated downward into one of the legs. Motor power loss, alterations in sensation and reflexes were associated with the pain but in varying

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degrees in different cases. In cases where compression of the nerve root had been prolonged and severe, recovery from the alterations in sensation, and reflexes were gradual, as is the case in the recovery and regeneration of any peripheral nerve following trauma. Very striking and rapid recovery of the motor power has been noted within a few days following operation in all cases with this envolvement in contrast to slow, sensory, and reflex recovery. The Kahn test was negative in all cases except one. Air was used for a contrasting medium instead of lipiodol in two cases with satisfactory results.

Report of Cases

Case 1.—In April 1937 while serving aboard a destroyer, this patient was lifting a blower to a shelf when the ship gave a lurch and there was a "snap" in his back. Symptoms incapacitated him more or less from about a week after injury to date of admission to hospital approximately 3 months later. The spinal fluid showed 35.5 mgm. of total protein per 100 cc. Lipiodol was injected but failed to show constriction of the spinal canal. Laminectomy with removal of a hypertrophied ligamentum flavum gave complete relief of symptoms.

E. L. G., male, 46 years of age, was admitted to the hospital on July 31, 1937. On April 19, 1937, while serving aboard a destroyer he was putting a portable blower on a shelf with his feet wedged between two other blowers on the deck. The ship gave a lurch to port which swung him around with the blower in his hands. As he swung around he heard a "snap" in the small of his back. He felt no particular ill effects from his experience for about a week afterward, and then one night after a card game he could not get up. From that time on he could not sit on his left buttock.

He was admitted to the hospital complaining of severe pain in lower left side of back extending down to the left knee and greatly exaggerated by any motion involving flexion of the thigh on the pelvis. Walking, sitting down, coughing, and sneezing exaggerated the symptoms. After about 2 weeks in bed he felt improved and returned to his ship but he was readmitted after about a week because his left leg was now so weak that when the ship would lurch he could not maintain his balance and consequently he was frequently thrown down. Examination now showed motor weakness in the distribution of the anterior tibial nerve—namely the tibialis anticus, the extensor longus digitorum, the extensor longus hallucis, and the peroneus tertius muscles, marked pain in small of back on straight-leg raising test on left side, hypesthesia in left buttock and groin, shuffling gait with dragging of the left leg, trunk bent to left side and left patellar reflex almost absent.

Rest in bed for about 5 weeks resulted in no improvement. Roentgenograms showed a crush fracture of the upper anterior half of the fourth lumbar vertebra, with irregular calcareous deposits and spur formation at its lateral and anterior margins, also spur formation of the third lumbar and the lumbosacral joint. The fifth lumbar was displaced posteriorly with the posterior surface of the body impinging on the canal and the lumbosacral angle very acute. Pelvis was assymmetrical. Lumbar puncture showed 35.5 mgm. of total protein per 100 cc. of fluid. The Queckenstedt test was negative. Lipiodol was injected into the spinal canal but the following roentgenograms failed to show any constriction of the spinal canal.

Laminectomy was performed on September 14, 1937, at which time the laminae of the third, fourth, and fifth lumbar segments were removed. An hypertrophied

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ligamentum flavum was found constricting the dural sac and was removed. There was also a definite angulation of the canal between the fourth and fifth lumbar segments. Convalescence was uneventful.

Examination on April 4, 1938, showed station and gait were normal. No subjective complaint was present. Babinski and Romberg tests were negative. The muscle tone was normal and there was no motor paralysis or paresis. Patellar reflexes were sluggish. This case had complete relief of all subjective symptoms.

Case 2.—Low back pain with a long history extending over approximately 25 years. Laminectomy with the removal of hypertrophied ligamenta flava completely relieved all subjective symptoms.

C. S. P., male, 45 years of age. In 1913 he fell from a hammock aboard ship a distance of about 7 feet and struck on his back. After this accident there was stiffness and soreness in the left hip which exercise and routine work increased. Symptoms gradually increased until 1914 when he was placed in a cast for about 45 days with much relief. He has however, had constant trouble with the left hip, thigh, and leg since his fall and has been in many hospitals for treatment. In 1918 he contracted pneumonia after which above symptoms were worse, and he was forced to stay in bed or a wheel chair much of the time. Symptoms persisted down through the years in varying degree until May 1937 he was admitted to a naval hospital for about 4 months and left feeling much better for a few months and then old symptoms returned.

He was admitted to this hospital on December 6, 1937, complaining of constant severe pain in the left lumbar region which radiated down the left thigh. Examination at this time revealed a marked scoliosis with the convexity to the right and marked tilting of the pelvis. Gait indicated much pain upon walking. There was tenderness along the course of the left sciatic nerve, and the straight-leg raising test on the left side induced great pain in lower back and along the course of the sciatic nerve. Postural changes induce paresthesia in the left lower extremity. Left great toe and left foot weak on dorsiflexion. There was numbness and tingling along the back and outer side of the left leg.

Roentgenograms showed a moderate degree of chronic hypertrophic osteoarthritis in the thoracic and lumbar segments. Spinal puncture was made and the pressure was normal. The fluid showed a total protein of 75 mgm. per 100 cc. The roentgenograms after injection of 5 cc. of lipiodol showed a distinct filling defect at level of the intervertebral space between the twelfth thoracic and the first lumbar segments, with an indentation on the right side.

Laminectomy was performed on January 31, 1938, at which time the laminae of the twelfth thoracic, and first and second lumbar segments were removed along with the hypertrophied ligamentum flavum which was causing a narrowing of the spinal canal between the twelfth thoracic and the first lumbar segments. Dural canal opened for inspection and to remove the lipiodol. Postoperative convalescence was normal.

On March 31, 1938, examination revealed patient without subjective symptoms. Kernig's test was negative. There was no pain from movment of the left leg through 135°. Gait and posture were normal. There was no pain or discomfort on walking. Postural changes produced no paresthesia. There was no motor weakness. Achilles reflex was absent on the left side. Sensation for pain, touch, and temperature was dull on the left calf from the popliteal space to the tendo Achilles in the lower third. Joint and muscle sense was intact.

Case 3.—A case of low back pain following a spinal injury about 8 years ago with complete relief from pain and the motor function restored, but with some sensory residuals still present.

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W. R., male, 51 years of age. In 1930 while getting into small boat from a ship he fell and struck his back. Following his accident there was tenderness in the left costovertebral angle with pain on bending to the right or upon hyperextension of the back. Roentgenograms in 1930 showed an impact fracture of the twelfth thoracic vertebra. A body cast was applied for 2 months and followed by physiotherapy for several weeks after removal of cast. Since the fall in 1930 there was more or less pain in the lower lumbar region and twinges of pain radiating like electric waves down the back of the left thigh and leg to the toes. Since early in 1937 his condition was so bad he was almost strictly confined to his bed and sleep was frequently prevented. The constant pain and lack of sleep had almost completely broken patient down. Coughing and sneezing was noted to aggravate the pain.

He was admitted to the hospital on December 6, 1937. Examination showed numbness in the back of the left leg from the middle third of thigh downward, over the calf and to the outer aspect of the left foot. Hyperesthesis on the anterior surface of the left thigh extending down to the patella. Muscles of the left leg showed marked atrophy. Tibialis anticus and extensor proprius hallucis on left side very weak. Patient was markedly bent forward and to the left. Walking very difficult and only possible by holding to something. The steps were very short and feet were just shuffled along the floor. Remainder of history and physical findings essentially negative.

Spinal puncture was done and the pressure was normal. The fluid showed 85 mgm. of total protein per 100 cc. Five cc. of lipiodol were then injected and roentgenograms revealed an apparent narrowing of the spinal canal between the second and third lumbar segments.

Laminectomy was performed on January 13, 1938. The laminae of the second, third, and fourth lumbar segments were removed along with the very enlarged ligamenta flava. The intervertebral disk between the second and third lumbar segments protruded posteriorly and this with an enlarged ligamentum flavum produced a constriction at this level. Postoperative convalescence was uneventful. The motor weakness was gone within a few days after operation but patient was generally very weak from long stay in bed and was unsteady when first starting to walk.

On March 31, examination revealed station and gait were normal. No motor weakness of the left foot was present. The sensory disturbance of the left thigh, leg and foot remained. Left Kernig's test was positive. There was motor restoration and relief from pain but sensory disturbances were still present.

Case 4.—Low back pain with some motor and sensory disturbances following a fall about 6 months ago. Fractures of two articular facets in the lumbar region and narrowing of the spinal canal between the fourth and fifth lumbar vertebrae were found. Laminectomy was followed by relief of pain and marked motor and sensory improvement.

E. C. Y., male, 31 years of age, was injured in September 1937 when he slipped and fell aboard ship as he was pulling on a line. In the fall he struck the small of his back. After the fall he felt a "catch" in the lower back especially upon sitting down. This condition lasted for a few days and then disappeared only to recur. The catch was described as consisting of a pain in the lower left side of back which radiated downward to the thigh.

Patient was admitted to hospital on February 20, 1938, complaining of the above symptoms. Examination revealed marked difficulty in walking and a definite painful area in the midline over the lower lumbar segments and the upper sacral region was present. This pain was aggravated by straight-leg raising and Kernig's test on the left side and by rotation of the spine. A neuro-

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logical study showed definite motor weakness in flexion and extension of the left foot and toes. There was dullness and hyperesthesia of the left hip and calf muscles. Left foot was uniformly anesthetic to light touch and to temperature from the ankle down. Deep and superficial reflexes were active and equal. The neurological finding followed closely the course of the left sciatic nerve. The right side was essentially negative. Patient suffered excruciating pain during neurological examination.

A spinal puncture was done. Queckenstedt test was normal. After withdrawal of 20 cc. of spinal fluid an equal amount of air was injected into the spinal canal with patient in Trendelenburg position. After this procedure the roentgenograms showed a comminuted fracture of the right inferior articular facet of the third lumbar vertebra and a similar fracture of the left superior articular facet of the fourth lumbar vertebra with an apparent narrowing of the spinal canal between the fourth and fifth lumbar segments. Total protein of the spinal fluid was 56 mgm. per 100 cc.

A laminectomy was performed on March 11, 1938, at which time the laminae of the second, third, and fourth lumbar vertebrae were removed along with the fractured articular facets of the third and fourth lumbar vertebrae and the hypertrophied ligamentum flavum between the fourth and fifth lumbar segments.

Postoperative convalenscence was uneventful.

Examination on April 12, 1938 revealed the motor weakness of the left foot and toes to be greatly improved. Restoration was at least 90 percent and there was no discomfort on motion. Station and gait were normal. Sensation of the posterior surfaces of the thighs was the same. Anesthesia of the left foot had given way to dullness. Restoration of thermal sense of left foot was not complete. Kernig's manipulation in an arc of 135° caused no pain. The straight-leg raising test caused some sciatic pain. Patient was taken into examining room for examination upon admission on a stretcher and could walk only with much difficulty whereas he now had a normal gait.

It will be noted that pneumomyelography was used in this case instead of the usual lipiodol. This procedure was advocated by Dandy in 1918, Coggeshall and von Storch in 1934, and Van Wagenen in 1934. Young and Scott reported 13 cases in a recent issue of the American Journal of Roentgenology, and described the technique followed in this case.

Case 5.—Following an injury in October 1937 patient had pain in the lower back radiating down the back of his right leg and an associated swelling of the right knee. Disability was at first thought to be arthritis and under rest and palliative treatment he had some temporary relief only to have same symptoms recur. Laminectomy was followed by complete relief of all subjective symptoms.

D. H. S., male, 22 years of age, was injured in October 1937 when he was attempting to reel up a heavy hauser alone. In doing this work he noticed a "kink" in the small of his back. About 3 or 4 days later patient noticed a backache to the extent he could straighten up only with difficulty. This pain in the lumbar region radiated down the back of his right thigh to his knee. About 2 weeks after initial injury the knee started to swell. He was then turned in on the sick list and palliative treatment was given. He felt improved after a few days and returned to duty but upon being seen limping about the deck he was again admitted to sick list and transferred to the U. S. S. *Relief*. He was considered a case of arthritis and was so treated for several weeks with some temporary relief but symptoms returned when he was up and around again. He was admitted to this hospital on December 8, 1937.

Examination at that time revealed a limping gait, a noticeable atrophy of the right lower extremity with marked weakness of that extremity, marked pain on

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pressure between second and third lumbar spines, motor weakness of the right thigh, leg, and foot, right Achilles reflex absent, and flaccidity of the musculature of right lower extremity. Roentgenograms were negative.

Spinal puncture showed fluid with 38 mgm. of total protein per 100 cc. Queckenstedt test was negative and the spinal fluid pressure was normal. Five cc. of lipiodol were injected and the roentgenograms now showed a narrowing of the spinal canal between the fifth lumbar and the first sacral segment.

Laminectomy was performed on March 11, 1938. The laminae of the fourth and fifth lumbar segments and the first sacral were removed. There was a definite stenosis of the neural canal between the fourth and fifth lumbar segments due to a hypertrophied ligamentum flavum which was removed. The patient complained of some mild pain over sacrum for a few days following operation which was thought to have been due to not complete removal of lipiodol at operation. Other than above convalescence was uneventful.

On March 31, 1938, the station and gait were normal. Tendon reflexes lower extremities, although sluggish, were elicited, including the right Achilles. Motor weakness of the right lower extremity had improved. Right thigh was still about 1 inch smaller than left in circumference. Muscle tone had improved and all subjective symptoms were gone. On May 4, it was noted the Achilles tendon reflex on the right side was about equal to the left side. The motor weakness was still further improved, the muscle tone was better and the right thigh was only about one-half inch smaller than the left. No subjective symptoms were present.

Case 6.—About 21 years ago patient had both femurs fractured and about 5 years ago a fracture of the right fibula with many abrasions. He apparently recovered from both accidents but about 1 year ago pain in right lower back came on and radiated down into the right leg. Symptoms became worse and sacro-iliac fusion was performed but did not relieve symptoms. Laminectomy was done with some improvement but a second laminectomy was performed at a later date due to persistence of some of symptoms. This case emphasizes the difficulty of correctly diagnosing some of the low back syndromes.

J. F. H., male, 42 years of age, had both femurs fractured with apparent excellent recovery. Then in 1933 patient was struck by an automobile and sustained a fracture of the right fibula and also multiple abrasions from which he apparently recovered, without sequelae. In the spring of 1937 without apparent cause patient began to have a right-sided low back pain with radiation down the right leg. At first he would have the pain about 1 day a week but as time went on the interval was shorter until he had pain almost constantly. It was noted that pain was relieved by lying on his right side and that walking greatly aggravated it.

He was admitted to the hospital on November 16, 1937, complaining of the above symptoms. Examination at that time showed a slow gait with patient bent forward and dragging the right foot. There was hypesthesia along the lateral sides of the thigh and lower one third of leg and of the ankle on the right side. There was marked restriction of flexion of the right thigh on the trunk and lateral rotation of the leg due to muscle spasm. There was marked tenderness over the right sacroiliac joint and the Kernig's and straight-leg raising tests gave extreme pain over the right sacro-iliac joint. Routine roentgenograms and laboratory tests were all negative. Due to symptoms and findings a sacro-iliac fusion was performed on December 27 but this did not relieve the subjective symptoms presented.

Spinal puncture was done on January 24, 1938. The hydrodynamics were normal. There were 62.5 mgm. of total protein per 100 cc. of spinal fluid. Five cc. of lipiodol were injected into the dural canal. Roentgenograms now showed a

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stenosis at the level of the intervertebral spaces between the third and fourth and between the fourth and fifth lumbar segments with a defect in anterior aspect of canal. The fourth lumbar segment was approximately .7 cm. posterior to the fifth segment but had excellent alignment with the third and other segments. There was a distinct narrowing of the posterior foramina between the fourth and fifth segments.

Laminectomy was performed on January 31, 1938. The laminae and hypertrophied ligamentum flavum, causing stenosis between the fourth and fifth segments, was removed.

Postoperative recovery was satisfactory and on April 1, 1938, examination showed paresthesia of the right foot and anterior outer aspect of right leg when walking and he was able to walk but a few blocks. The station and gait were normal. Flexion of the thigh on the abdomen caused no pain. Kernig's manipulation was negative. The knee jerks were hyperactive but equal. The right ankle jerk was absent. Babinski was negative. Abdominal reflexes were normal. The lower third of the anterior surface of leg and the dorsum of the foot showed diminished sensation to light touch. Muscle tone was good and there was no motor weakness or atrophies.

A second laminectomy was performed on April 19, 1938, because it was thought that at the first operation the laminae had not been removed high enough up. Patient recovered from the operation satisfactorily but it is questionable as yet whether his subjective symptoms have been entirely relieved.

Case 7.—In 1931 patient fell and struck the lumbar spine against a light socket and some mild low back symptoms followed. Then in December 1937 he was lifting some sand and felt a "catch" in his back and had difficulty straightening up. Pain radiated down the back of the right leg. Later there was numbness in foot and he was bent forward and to the left side. Laminectomy with removal of a hypertrophied ligamentum flavum and a nucleus pulposus relieved the pain. Sensory symptoms are much less marked but are still present to some degree.

F. M. E., male, 52 years of age, fell and struck the lumbar spine against a light socket in 1931. The mild symptoms which followed were not disabling and he apparently recovered. Then in December 1937 while lifting some sand a pain came on in the small of the back so he could not straighten up except with difficulty. Pain radiated down the back of the right leg and he was treated for neuritis. Rest improved pain which extended from the middle of the thigh posteriorly downward and from the knee downward anteriorly. Stooping and drawing of trunk to left appeared about March 1. The condition became worse.

He was admitted on April 25, 1938. Examination then showed the marked stooping posture, pain running down the back of right leg and increased by coughing or pressing at times on a small tender area to right of the fourth lumbar segment, paresthesia involving the second and third toes, deep reflexes active in both legs, and bilateral pseudoclonus. Kernig's and straight-leg raising tests increased pain in back and right leg. Kahn four plus. Routine laboratory studies were otherwise negative.

A spinal puncture was done and the hydrodynamics were normal but there was marked increase of the pain in the right leg as the dura was punctured. Protein was 45.4 mgm. per 100 cc. Eighty cc. of spinal fluid were removed and an equal amount of air was injected with patient in Trendelenburg position in which he was maintained until operation upon the morning of the second day. Pneumomyelograms revealed a funnel-like narrowing at the level of the interspace between the third and fourth lumbar segments and extending half the width of the fourth lumbar segment. Narrowing was greater on the anterior aspect

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Laminectomy was performed on April 28, 1938. An hypertrophied ligamentum flavum was found between the third and fourth lumbar segments and a loose, smooth, oblong cartilaginous body about 1 by ¾ cm. was found beneath the articular facet on the right side between the third and fourth segments. Both were removed.

The pain in back and right leg was gone within 3 days but sensory disturbance in toes was slow in disappearing, so longer observation will be necessary to determine if sensory disturbances will be relieved.

Case 8.—Approximately 2 years before admission patient injured his back on a construction job. No definite symptoms developed until about 3 months after accident when a low back pain was noted in the mornings. After a few more weeks he noticed pain that ran downward into the right thigh. Condition gradually became worse and he sought relief in several places. He was admitted with no improvement on November 16, 1937, and following a laminectomy he was improved, discharged, and returned on May 9, 1938, for a second laminectomy which apparently relieved his remaining symptoms.

H. E. N., male, 41 years of age, was injured in November 1936 while working on a construction job when he became pinned under some heavy pieces of steel. There were no very definite symptoms for about 3 months, then he had some difficulty getting out of bed in the morning due to pain in lower back. This was better after he was up and around awhile. The condition gradually grew worse until the pain was present practically all the time. He consulted several specialists with no relief and was sent to this hospital by the Veterans' Administration on November 16, 1937, which was approximately 1 year after injury. He complained of pain in lower right side of back and right hip with radiating pain into the right thigh and lower leg. Examination revealed pain along the posterolateral and anterior surfaces of the right thigh and the outer surface of the right lower leg. In the same distribution there was diminished temperature and light touch sensation. Kernig's and straight-leg raising tests on right side increased the pain. Achilles reflex on right side was absent and patellar reflexes of both legs were sluggish. All routine laboratory work was negative.

A spinal puncture was done with normal hydrodynamics. Total protein of spinal fluid was 58.8 mgm. per 100 cc. Five cc. of lipiodol were injected into the dural canal. Roentgenograms showed stenosis of the canal at level of the second and third lumbar segments.

Laminectomy was performed on December 20, 1937, and an enlarged ligamentum flavum and bone stenosing the dural canal between the second and third lumbar segments were removed. Postoperatively there was some pain in the right hip and thigh but this appeared to improve.

Examination on March 31, 1938, showed a negative Kernig through an arc of 135°. Plantar reflexes very sensitive. Tendon reflexes very sluggish and the right Achilles reflex was absent. Station and gait were normal. Right outer and anterior surfaces of thigh were dull for pain, temperature, and light touch. No motor weakness was present. He still complained of pain on the anterior surface of thigh.

The neurologists thought one segment lower should also be removed and on May 10 a second operation was performed at which the lamina of the fourth lumbar segment was removed along with the hypertrophied ligamentum flavum at that level. Within a week patient stated pain was gone.

Case 9.—Following injuries in 1924 and 1927 patient had low back pain with radiation downward into the left leg. In March 1937 he was admitted to hospital and treated as a case of neuritis with some temporary relief, and he returned to

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duty. Symptoms were soon worse than ever before and he returned to hospital. An old fracture of the coccyx was found and removed but without relief. Then following injection of lipoidol into the dural sac and roentgenograms a stenosis was found between fourth and fifth lumbar segments. Laminectomy with removal of an enlarged ligamentum flavum was followed by complete relief of pain and improvement of sensory disturbances.

C. R. B., male, 46 years of age, was admitted November 8, 1937, complaining of severe pain in lower left lumbar region with radiation down the left leg. He gave a history of falling and striking his sacrum on a tool box in 1924 after which he was in hospital for 2 months. In 1927 he fell down some steps and struck the small of his back on the steps. He had pain off and on in the lower lumbar region and left leg until 1932 when he was again in a hospital for treatment. He was improved after a time and returned to duty. In March 1937 symptoms, which had been more or less constant for the past several years, became so severe he was admitted to hospital with diagnosis of neuritis. He improved, had an old fractured coccyx removed, and returned to duty. Symptoms returned and he was unable to carry on so he was admitted to hospital again in November 1937. Examination now revealed severe pain in the lower left lumbar region with radiation downward into the posterior surface of the left buttock and thigh. There was also numbness along the outer surface of the left thigh, lower leg, and foot. There was diminished light touch and heat sensation also associated with the numbness. Achilles reflex was absent on left side. Patellar reflexes were present but sluggish. Gait was slow and shuffling due to pain. Kernig's and straight-leg raising tests increased the pain. No motor disturbance was present.

A spinal puncture was done and the hydrodynamics were normal. The spinal fluid showed 66 mgm. of total protein per 100 cc. Five cc. of lipiodol were injected into the dural sac and the roentgenograms now showed a stenosis of the sac between the fourth and fifth lumbar segments. Laminectomy was performed on November 23 and an enlarged ligamentum flavum was removed between the fourth and fifth lumbar vertebrae. The dural sac was opened for examination and the lipoidol was removed. Postoperative recovery was uneventful.

Patient was discharged to duty on February 18, 1938, at which time there was no pain. The numbness was limited to small area on the outer surface of the left foot. Achilles reflex and patellar reflexes showed approximately no change. Kernig's and straight-leg raising tests were negative. Gait was normal. He was relieved of subjective symptoms and sensory disturbances were improved. He has not been seen since discharge to determine if further improvement has followed.

Comment

There has not been sufficient time elapsed to permit a report on the end results in all cases of this series. There was prompt relief from pain in all cases except one and this case was improved and felt the operation was worth while. Sensory and reflex disturbance are apparently much slower in disappearing so prolonged observation is necessary to determine the degree of recovery from these disturbances. It would seem that the prognosis will be much better in cases of lesser degree and of short duration than in old cases where nerve damage is severe.

The use of air instead of lipoidol offers a safe and satisfactory contrasting medium in the study of the low back pain without some of the bad features of the later such as desirability for removal at operation and possible nerve irritations which sometimes follow its use.

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SUMMARY

Laminectomy with the removal of enlarged ligamenta flava and nucleus pulposus gives striking relief of symptoms in selected cases of low back pain. The trauma which usually precedes the pain was of slight degree in the majority of our cases. Microscopic section of the removed enlarged ligaments will show definite pathological changes.

The question of differential diagnosis of conditions causing low back pain is at times extremely difficult and at times impossible even with the most carefully taken history, physical and special examinations, including the injection of air or lipiodol into the dural sac, and a thorough neurological study. Compression of the nerve roots may be caused by an enlarged ligamentum flavum, a nucleus pulposus, a fractured lamina, pedicle, or articular facet, or a protruding intervertebral disk to name a few conditions likely to be found.

After the nerve roots emerge from the dura they lie in the very narrow space between the ligamentum flavum and the intervertebral disk. A minor enlargement of the ligament, or a posterior protrusion of the disk, or a combination of the two, may be sufficient to cause pressure of the nerve roots.

All cases in this series have been operated upon within a period of 8 months and all revealed enlargement of the ligamentum flavum. One case showed a moderate posterior protrusion of the intervertebral disk, one a nucleus pulposus, and one fractured articular facets in conjunction with the stenosis of the dural canal. Operative removal of the pathology present in the respective cases gave prompt relief of pain and motor impairment in all cases except one which was improved. A second laminectomy was necessary in two cases. Sensory and reflex disturbances are apparently more slow to return than motor disturbances.

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HYPERTROPHIED LIGAMENTUM FLAVUM

By Lieutenant (Jr. Gr.) Joseph J. Timmes, Medical Corps, United States Navy

Enlargement of the ligamentum flavum causes low back pain with sciatic radiation. It is a definite clinical entity and first appeared in the literature in 1913 in a report by Elsberg. It is much more common than generally considered, two cases having been treated by laminectomy within 2 months at the naval hospital, Philadelphia. It is seen in that group of patients who have been labeled lumbosacral and sacro-iliac disease. They are the patients who have been treated without success by physical thereapy, exercises, strapping, manipulation, traction, and even fusion operations.

Anatomically the ligamenta flava are described by H. A. Brown as arising from the dorsal and upper margins of each lamina, pass upward beneath the lamina immediately above, and enter the neural canal. They fuse in the mid-line and laterally have expansions which extend well down toward the anterolateral aspects of the neural canal and form the posterior margins of the intervertebral foramina. Directly below each ligament lies the intervertebral disk, and the very narrow space between them serves as a passage for the nerve root after it emerges from the dural canal. Normal ligaments are composed entirely of yellow elastic fibers and grossly have considerable elasticity.

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The etiology is not definitely known but a history of trauma, usually of a slight degree, is rather common. Some patients describe a snapping sensation at the time of the injury. At this time rupture of the elastic fibers of the ligamentum occurs and the fibers retract. Healing occurs by cicatrix formation which later undergoes hypertrophy. The hypertrophied cicatricies then cause a compression of a nerve root with the resultant symptom complex. The ligamentum pathology may exist alone or in conjunction with a protrusion of an intervertebral disk.

The chief complaint is low back pain with sciatic radiation. Characteristically the pain is aggravated by sneezing, coughing, and straining, especially at time of defecation. Some degree of scoliosis with a list to the unaffected side is rather common. The most constant objective finding is an absence or a decrease in the Achilles-tendon reflex. The motor and sensory disturbances depend on the area of the cord in which the compression occurs. Sensory changes may be present over the buttocks, perineum, posterior thigh, calf and foot. Motor weaknesses found usually occur in the anterior tibial muscles. A general restriction of the movements of the back is commonly seen, as is severe pain on straight leg raising. Remissions may occur so that the patient may be free of symptoms for an interval that may even extend over a number of years.

Plain roentgenograms show no pathological change. Diagnosis requires a spinal puncture with the introduction of lipiodal. The spinal fluid frequently shows an increase in total prôtein, but this finding is not constant. The puncture is made at a low level, between the fourth and fifth lumbar vertebrae and 4 to 5 cc. of lipiodal are introduced. The flow of the lipiodal in the spinal canal is viewed under the fluoroscope and films are taken. Notching of the lipiodal column, an irregular protrusion into the canal or an hour-glass construction are the findings commonly seen. These films should be rechecked.

The treatment consists of surgical removal of the hypertrophied ligament in order to free the nerve root from compression, by means of laminectomy. A wide lateral removal of the ligament is recommended. The results have been excellent and attended with little risk. The relief of pain soon manifests itself and there is a gradual improvement in the sensory and motor disturbances.

Case Report

Case: J. F., male, veteran, 49 years of age. Admitted to hospital ambulatory on August 2, 1938, complaining of low back pain radiating to the right leg for the past 10 months. The onset was insidious but progressively became more severe. Bending forward caused a great deal of pain. There was pain and tingling down the right leg on sneezing and defecating. No history of injury to the back recalled by patient. Before admission, patient had been treated by massage, application

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of heat, chiropractor adjustments, sacro-iliac belt, and even had his leg manipulated under anesthesia and placed in a cast, but to no avail.

Physical examination was essentially negative except for point tenderness over the sacrosciatic notch and over the sacro-iliac joint on the right side with pain referred to the posterior aspect of the thigh and popliteal space on forward or lateral trunk motion.

Neurological examination revealed a slight hyperesthesia below the distribution of the third lumbar segment but not marked. Slight hyperalgesia existed over the middle third of the left thigh. There was a one plus Babinski present on both sides.

Kahn test was negative and both the blood picture and the urinalysis were normal. No foci of infection could be found. X-ray examination of the lumbosacral spine was negative for bone pathology. X-ray examination of the second metatarsophalangeal joint of the left foot showed an osteochondritis of the head of the second matatarsal, sometimes known as Freiberg's infraction. It was believed, however, that this latter finding had no bearing on the low back pain.

The lumbosacral ligaments and the right pyriformis muscles were injected with 1 percent novocaine followed by a moderate relief of symptoms.

A spinal tap was performed with the needle in the fourth lumbar interspace and the spinal fluid obtained was markedly xanthochromic, a canary yellow. The fluid was under a decreased pressure and about 5 cc. was obtained. A Queckenstedt revealed almost a complete block and the fluid stopped flowing. Another needle was inserted in the second lumbar interspace and the fluid obtained was under normal pressure, flowed freely. Queckenstedt test did not reveal a block but the fluid was moderately turbid. Examination of the spinal fluid showed a heavy increase in globulin and a cell count of 1,400. Another spinal tap was performed and 4 cc. of lipoidal injected for x-ray visualization. The spinal fluid removed at this time showed a cell count of 14, 80 percent lymphocytes and 20 percent polymorphs, a moderate increase in globulin, total protein 105 mgms., sugar 70 mgms., and chlorides 745 mgms. Roentgenographic examinations showed that the lipoidal extended down as far as the midzone of the second lumbar vertebra. None of the lipoidal was present in the canal below this level in any of the views, including one with the head elevated. Pneumospinogram with lipoidal above the block repeatedly showed the obstructive lesion in the same area.

Laminectomy was done on September 12, 1938, and the lamina of the second, third, and fourth lumbar vertebra removed. An enlarged ligamentum flavum about one-fourth inch in thickness was found constricting the cord and pulsations were present above the constriction. A wide removal of the hypertrophied ligament was performed and the constriction relieved. Upon opening the dura the arachnoid underlying the enlarged ligament was hypertrophied, covered by a plastic exudate and showed chronic inflammatory changes. Microscopic examination of the specimen removed showed typical fibrotic scarring and marked degeneration and derangement of the yellow elastic fibers. A few small areas of calcification were also present.

The postoperative condition was uneventful except for urinary retention and pain in both legs which cleared up after a few days. Check x-ray studies revealed the passage of lipiodal through the previous area of constriction. The low back pain gradually disappeared and the patient no longer complained of pain radiating along the sciatic nerve. The Babinski disappeared and the sensory changes returned to normal. Patient was seen in May 1939 at which time he was free of all symptoms.

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COMMENT

This case is noteworthy in that a complete block existed in the spinal canal. So far as we have been able to investigate no other case has been reported in the literature in which an enlarged ligamentum flavum has caused a complete block. By surgical exploration this case definitely proves that such a condition can and does exist. This case also showed a blockage by the Quechenstedt test which according to Naffziger, Suman and Saunders is exceptional. Xanthochromia of the spinal fluid is also a most unusual finding.

INCISION OF FASCIA LATA

FOR RELIEF OF LOW BACK PAIN WITH SCIATICA WITH CASE REPORTS

By Commander Joseph B. Logue, Medical Corps, United States Navy

Low back pain with sciatica is a frequent and distressing disability. These cases have often been the rounds of doctors, osteopaths, and chiropractors with little improvement and in many cases with little sympathy from the profession. Too frequently they are the victims of suspicion that they are exaggerating their symptoms and are discouraged and at times at their wits end. In the military service they are often thought to be malingering, specially those in whom no demonstrable pathology is found on the rounds of examination including negative x-ray, no foci of infection, normal sedimentation rate. They become morose, depressed, and one of the most striking features is their mental attitude toward everybody and everything, realizing that little progress is being made toward their improvement. Many of these cases in the Navy finally come to survey from the service after many months of treatment.

That a large percentage of these cases can be cured by incision of the iliotibial band and fascia lata is being gradually proven as statistics of more operative cases are recorded.

HISTORICAL REVIEW

Heyman[1] writing in the Journal of Bone and Joint Surgery observed that in cases of sacro-iliac fusion it was noticed that the symptoms were relieved sometimes immediately following operation, and that in others the symptoms were relieved too soon after operation for actual fusion to have occurred. Therefore there must have been in these cases some other factor than the actual fusion that relieved the symptoms. He states: "It is admitted that arthrodesis of the sacro-iliac joint is followed by a complete and lasting relief of symptoms, * * *. However, observations common to all of us make

[1] Heyman, C. H., Thoughts on relief of sciatic pain, J. Bone and Joint Surg. 16: 889-894, Oct. 1934.

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one doubt that a sacro-iliac lesion is necessarily the usual cause of sciatic pain." Following his observations he operated two cases by stripping fascia and muscles from their attachments over the posterior surface of the ileum with excellent results. The first case in 1927 and the second in 1933.

Ober [2] reports how Doctor Percy Roberts "12 to 14 years ago, operated on a patient with sciatic pain to relieve what seemed to be a pathological condition of the ilium as shown by x-ray. The Smith-Peterson incision was used. No bone pathology was found and the wound was closed. The patient was relieved". Roberts repeated this operation in 16 cases and obtained relief in 15 of them.

Freiberg [3] with a somewhat similar deduction was impressed by the fact that there must be other factors than the sacro-iliac joints responsible for the sciatic pain in these conditions and came to the conclusion that the piriformis muscle was the cause of the pain as the sciatic nerve was impinged as it came out beneath the piriformis. He performed incision of the piriformis muscle with excellent results.

Pitkin and Pheasant [4] of San Francisco have written an interesting series of articles based on an analysis of 506 examinations for low-back disability. In their conclusions they state:

> The term "sacrarthrogenetic telalgia" accurately describes the syndrome of pain which originates in the sacro-iliac and sacrolumbar articulations and their accessory ligaments. The referred pain (telalgia) affects the gluteal or the sacral region, or both regions, and may affect any part or all parts of the lower extremities and genito-inguinal regions except the internal crural and plantar regions. The lesions that produce this type of pain are associated with lateral spinal scoliosis. They do not cause objective neuropathological manifestations other than reflex physiopathic disorders and the atrophy of disuse.

In 1935 [5]–36 [2] and 1937 [6] Ober published a series of articles on low-back pain with sciatica in which he had obtained excellent results by incision of the iliotibial band. He described in detail the physical findings, the criteria for the operation, and the operation itself, which he has modified somewhat from the original.

Since Ober's excellent articles there have been numerous reports, some critical, as that in the American Medical Association Journal of 1935 by Snodgrass,[7] but others substantiating his findings. Smith [8] reported excellent or good results in 75 percent of 20 cases.

[2] Ober, F. R., Role of iliotibial band and fascia lata as factor in causation of low back disabilities and sciatica, J. Bone and Joint Surg. 18: 105–110, Jan. 1936.

[3] Freiberg, A. H., Sciatic pain and its relief by operations on muscle and fascia, Arch. Surg. 34: 337–350, Feb. 1937.

[4] Pitkin, H. C., and Pheasant, H. C., Sacrarthrogenetic telalgia; study of referred pain, J. Bone and Joint Surg. 18: 111–133, Jan. 1936.

[5] Ober, F. R., Back strain and sciatica, J. A. M. A. 104: 1580–1583, May 4, 1935.

[6] Ober, F. R., Relation of fascia lata to conditions in lower part of back, J. A. M. A. 109: 554–558, Aug. 21, 1937.

[7] Snodgrass, L. E., In defense of the fascia lata and the iliotibial band: A comment on back strain and sciatica, J. A. M. A. 105: 1135–1137, Oct. 5, 1935.

[8] Smith, A. De f., Results of fasciotomy for relief of sciatic pain, J. Bone and Joint Surg. 19: 765–769, July 1937.

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Ober [6] from reports through questionnaires and his own cases has reports from 415 cases up to 1937 with the following results: Complete relief of symptoms 75 percent; partial relief 4 percent; no relief 21 percent.

ANATOMY

The fascia lata forms a tubular investment for the muscles and vessels of the thigh and buttock. It is firmly attached above to the iliac crest, the sacrotuberous ligament, the ischium, the pubic arch, the pubic symphysis and crest, and the inguinal ligament. In the distal part of the thigh it forms the intermuscular septa. On the lateral side of the thigh it forms the iliotibial band, a broad thick layer of fascia which is attached above to the iliac crest, and receives the insertions of the tensor fascia latae, and part of the gluteus maximus muscles. Its distal attachment is to the capsule of the knee joint and the lateral condyle of the tibia. A strong band of fascia continued proximally from the iliotibial tract, beneath the tensor fascia lata muscle, joins the tendon of origin of the rectus femoris and the capsule of the hip joint.[9]

PATHOLOGY

The origin of the muscular attachments of the gluteus maximus and the tensor fascia lata represents the base of a triangle whose apex is over the lateral aspect of the femur just below the trochanter. When there is shortening of the iliotibial band and its fascial expansion, there is an abduction contracture of the femur, resulting in a tremendous leverage action on the sacro-iliac and lumbosacral joints. In most instances, the anterior portion of the fascia lata is contracted; in some the posterior portion is contracted. The sciatic nerve lies beneath the gluteus maximus where it emerges below the piriformis and any contracture of the fascia lata must exert muscular pressure on this nerve. In operations on the iliotibial band, the gluteus maximus muscle has been found to show more or less spasm.[2]

Jostes [10] in his mechanism of low back pain quotes Kendall of Baltimore to the effect that the "affections may result from postural muscular imbalances * * *"; as foot pronation which in turn weakens the external rotators of the thigh with a consequent shortening of the internal rotators as the tensor fascia lata or "in the reverse direction" of Doctor Ober, and that the shortening or taut fascia is the result of the muscular imbalance, that cause low back pain, instead of the shortened iliotibial band being the primary cause.

SYMPTOMS

The patients complain of pain over the sacro-iliac or lumbar region, usually one but at times both sides, with pain radiating along the course

[2] Ober, F. R., Role of iliotibial band and fascia lata as factor in causation of low back disabilities and sciatica, J. Bone and Joint Surg. 18: 105–110, Jan. 1936.

[6] Ober, F. R., Relation of fascia lata to conditions in lower part of back, J. A. M. A. 109: 554–558, Aug. 21, 1937.

[9] Cunningham's "Text Book of Anatomy", Fifth edition, William Wood and Co., New York.

[10] Jostes, F. A., Low back pain, Mil. Surgeon 83: 316–326, Oct. 1938.

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and distribution of the sciatic nerve or branches. They will tell you that there is a feeling of tightness over the lateral surface of the thigh and one case had a definite snapping as the taut iliotibial band played across the greater trochanter on movement of the thigh.

EXAMINATION

1. These patients usually show signs and symptoms which are found with those of low back pain. There is scoliosis if unilateral or a definite lordosis if both sides are involved. Pain over the sacro-iliac region and along the sciatic nerve distribution. There is usually spasticity of the lumbar muscles on the side affected.

2. Forward bending is limited and the patient is unable to touch his hands to the floor and he will tell you that there is a feeling of tautness along the outer border of the thigh and hamstring region.

3. When sitting on examining table, forward bending is limited and if told to touch his toes he will bend his legs at the knees.

4. With the patient prone on the table, straight leg raising is limited or if the thigh is flexed on the abdomen as flexion progresses the pelvis will be raised from the examining table—Ely's sign.

5. Ober's sign. The patient is placed on his side with the leg nearest the table flexed to a right angle. The examiner places his hand on the pelvis to steady it and grasps the patient's ankle lightly with the other hand, holding the knee flexed at a right angle. The thigh is abducted and extended. Then the leg is allowed to descend of its own weight. It is held in abduction if the iliotibial band is contracted. Otherwise it will descend to the table.

6. The iliotibial band is usually extremely tight and prominent and is often very rigid and distinctly felt as a rigid raised band when put under tension.

7. The x-ray of sacro-iliac and lumbar vertebra is negative. Those cases showing definite arthritis should be eliminated.

OPERATION

Local anaesthesia is used. An incision is made in the skin extending from just posterior to the anterior superior spine of the ilium backwards to 1 inch above and posterior to the greater trochanter. The skin incision is carried through the subcutaneous tissue to the fascia lata. The fascia lata is cleared for 1 inch above and 1 inch below. The fascia is then incised well forward to the tensor fascia and posteriorly as the fascia extends. The thickened fascia retracts as it is cut with a resultant separation of about 2 inches. The thick intramuscular septa must also be incised to allow complete retraction. A section is removed for histopathological examination and the subcutaneous tissue and skin is closed in the usual manner. The patient is allowed

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up in 4 to 5 days, completely up in a week, and skin sutures are removed in 10 days.

Some of the cases show immediate relief of sciatic pain, in others pain has disappeared in 5 to 10 days, and still others continue to show gradual improvement over a period of from several months to 1 year.

Following a study of Ober's articles all cases of low back pain with sciatica were examined in an effort to find cases that met his criteria.

The first case was one of a snapping hip. There was a definite snapping of the iliotibial band as it rode across the greater trochanter and the patient complained of pain over this area. It was our impression that the patient was exaggerating his symptoms as he definitely wanted to get out of the service and he was loath to have the operation. He was finally prevailed upon and consented to the operation. The snapping was relieved and the pain disappeared. He finally complained of pain over the operative scar to such an extent that he was surveyed from the service.

Since the above case, nine other cases have been operated. One case was a woman, another case was bilateral. The following case histories are representative of the group.

Case Histories

Mrs. A, age 45 years. She gradually developed pain over lower back, on the side and extending down the right sciatic region. The pain became progressively worse. She was seen by numerous physicians who prescribed various types of treatment without any relief. She finally went to a chiropractor or an osteopath who stated that her lumbar vertebrae were slightly out of place and would require adjustments. She followed this treatment until her money was exhausted. Her symptoms became more severe. In August 1937 the pain was such that she spent practically all of her time in bed, requiring frequent sedation.

Examination showed a middle aged woman of 140 pounds who appeared acutely ill. She assumed a position lying on left side with right leg flexed at hip and knee. The pain was over the right sacro-iliac region and extending down her right thigh. She was not cooperative and would not allow manipulation of the leg for the ordinary test. X-ray showed suggestive arthritic changes in lumbar and sacro-iliac region. Due to the arthritis she was advised conservative treatment. This was done for several months with no improvement and the patient had become practically bedridden. We finally decided to do an incision of the iliotibial band as further examination showed both Ely and Ober signs positive.

The operation was done under local anaesthesia. She was up in 5 days, home in 10 days, up and about and after 2 weeks she was performing her housework and has continued to improve so that she is now free from pain.

D. R. L.; CQm.; white; male; age 36. Admitted July 29, 1937, with pain down back of right thigh and unable to straighten out right leg. Symptomatic treatment was given. Pain increased in severity and he was unable to sleep. Pain extended down entire right leg to ankle but was more severe in upper thigh. In June he had a dull pain in right lower back which cleared up in 3 weeks.

On examination patient appeared in pain and unable to sit down unless weight was borne on left buttock. Right thigh and leg were kept semiflexed. There was tenderness along course of right sciatic nerve. He was unable to completely

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extend right leg. Marked lumbar lordosis with spasticity of lumbar muscles were present. Forward motion of lumbar spine was limited. He was unable to sit up to right angle with knees extended. There was marked tenseness of both iliotibial bands. Reflexes were normal. Ely's sign positive. Ober sign not positive, straight leg raising limited. X-ray of spine and sacro-iliac were negative.

There was only little improvement under rest, physical therapy, and treatment for elimination of possible foci of infection. Operated September 21, 1937. Both iliotibial bands were incised, Ober method. By October 7, 1937, pain was subsiding with marked improvement in lumbar lordosis. He was discharged to duty October 26, 1937, and has been doing duty since discharge. Patient states in follow-up letter dated August 10, 1938, that he is 95-percent improved.

J. F. I.; Lieutenant, U. S. N.; age 37. Admitted September 6, 1938, with diagnosis undetermined (neuritis, sciatic nerve). Chief complaint: Pain over lower back and down right leg. Began to have pain in his lower back about August 1. He was very active and tried to play badminton but this aggravated the pain. He slept well at night until August 15. Since then the pain disturbed his rest. Pain was aggravated by sitting. Therefore he did most of his work standing. Riding back and forth to work in his car aggravated the pain also. When he was sitting he had to get up every few minutes to relieve the pain. Pain was of an aching character and sharp when the leg was brought to a right angle.

He was treated conservatively until August 26, 1938, with very little improvement. Examination at this time showed tenderness over lower right sacro-iliac region and along the course of the right sciatic nerve. Forward bending was limited in both standing and prone positions. Ely's and Ober's signs were both positive. He was operated August 26, 1938, under local anaesthesia. The iliotibial band was incised where the band was found definitely thickened and taut. The band retracted about 2 inches on incision. The sciatic pain was relieved almost immediately. He was up in 6 days, sutures were removed on the 10th day and he was found fit for duty entirely symptom free on 17th day.

SUMMARY

A series of 10 cases of low back pain with sciatica operated by incision of iliotibial band and fascia lata, one case of which was bilateral, is reported.

Recent follow-up showed seven cases with no further symptoms.

Two cases stated no improvement had resulted.

One case stated he was still having symptoms. However, he has not returned to the hospital for further treatment.

CONCLUSION

These cases of low back pain with sciatica form a definite clinical entity. These cases must be differentiated from those of other definite pathological entity such as arthritis, hypertrophy of ligamenta flava or the dislocation of the intervertebral disk. A large percentage of these cases, properly diagnosed, may be relieved by incision of the iliotibial band.

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INJURIES INVOLVING THE ATLAS AND AXIS

WITH CASE REPORT

By Lieutenant Commander Robert E. Baker, Medical Corps, United States Navy

This discussion of fractures and dislocations involving the first two cervical vertebrae includes a case report of fracture of the odontoid process with unilateral forward dislocation of the atlas, interesting not only because of the rarity of the lesion, but also for the absence of neurological abnormalities and the lack of fatal result.

Authorities differ somewhat in their estimate of the prognosis in injuries to the atlas and axis but available statistics show that the mortality rate is quite high. Jefferson,[1] in July 1927, made a rather comprehensive tabulation of the total reported cases of atlas fractures which, at that time, amounted to 65 cases. Twenty of these were isolated fractures of the atlas and 45 were complicated by other injuries. Of the 45 complicated cases, there were 19 fractures of the odontoid process. Of these latter 5 recovered, but 2 of these died later, one 47 weeks later of nephritis and the other 15 months later with osteomyelitis of the atlas and axis. His tabulation includes the author who reported the case, the nature of the accident, the clinical signs of cord or nerve injury, the anatomical diagnosis, and the result. Those who find themselves interested in the historical aspects of this subject will find his review an invaluable contribution.

The importance of these injuries is, of course, due to the proximity of the atlas and axis to the medulla oblongata and to their position above the roots of the phrenic and other nerves governing respiration.

The first two cervical vertebrae are modified to allow free motion of the head and differ materially from the other vertebrae. The atlas consists of a ring of bone having two elliptical, concave, fossae on the superior surface for the reception of the occipital condyles and on each side is a long transverse process which is perforated by a foramen for the vertebral artery. On the posterior surface of the anterior arch there is a small circular and slightly concave facet for the odontoid process of the axis.

The axis consists of a body and four articular processes but its characteristic feature is the presence of the odontoid process which is about three-fourths inch in height and projects upward from the body of the axis occupying the anterior portion of the ring of the atlas. The axis is further characterized by the breadth and strength of its spinous processes, the shortness of its transverse processes, and the prolongation downward of the forepart of the body.

The atlas and axis are bound together by dense ligaments which connect them to the occipital bone above and the other vertebrae below. The transverse ligament is a thick band of fibrous tissue

[1] Jefferson, G., Fractures of first cervical vertebra, Brit. M. J. 2: 153–157, July 30, 1927.

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which stretches across the ring of the atlas from side to side. It is one of the most important structures in the body for, when fractured, the odontoid ceases to be held against the anterior arch of the atlas and is free, on the slightest motion, to tilt backward and press upon the medulla oblongata which usually causes instant death.

The common injuries to the atlas are, in order of frequency, as follows:

1. Fracture of the posterior arch alone.
2. Fracture of both arches.
3. Fracture of the anterior arch alone.
4. Fracture of a lateral mass.
5. Fracture of a transverse process.

By far the most common associated fracture is that of the odontoid process of the axis. Dislocation of the atlas cannot occur without a fracture of the odontoid process occurring or a rupture of the transverse ligament, and the former is more common than the latter.

The vertebral artery may be ruptured in this class of injuries, particularly if there is a fracture of a transverse process but is considered rare because of the elasticity of the vessel wall and the usual lack of displacement of the bone fragments.

Injury to the great occipital nerve is common in fractures of the atlas and occipital neuralgia following trauma to this region should make one suspicious of fracture involving the atlas or axis.

DaCosta [2] states that a unilateral dislocation of the atlas seldom compresses the cord and gives a fair prognosis while a bilateral dislocation with fracture of the odontoid process gives an extremely bad prognosis.

FRACTURE OF THE ATLAS

Symptoms.—There is pain and rigidity in the neck, and motion of the head is slow and difficult. Some motion of the head is usually possible as the lower cervical joints permit of a certain degree of movement. Nodding movements, the movements of "Yes" and "No," are particularly difficult. Occipital pain and neuralgias or occipital anaesthesia may occur due to involvement of the greater and lesser occipital nerves. Dysphagia may be present and if so, is due to mechanical (muscular) cause. The only certain means of diagnosis is radiography (Jefferson). The x-ray will demonstrate the lesion in a lateral view or taken anteroposteriorly through the wide open mouth.

Etiology.—This type of fracture is usually the result of a fall upon the head but may also be due to a heavy object falling from above and striking the patient upon the head. The blow of a direct force applied to the neck, such as being struck below the occiput with a club, etc., may also produce fractures of the atlas.

[2] DaCosta, J. C., Modern Surgery, General and Operative, Tenth Edit., pp. 759-769, 1931.

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Treatment.—The treatment consists in immobilization with plaster-of-paris, or with a mechanical or leather brace.

Prognosis.—Jefferson [1] found that since the introduction of radiography the prognosis has improved markedly. Before 1900, fracture of the atlas seemed to be uniformly fatal but since that time he noted 32 cases reported, of which only 6 have died. The mortality in the whole series, however, is over 50 percent.

UNILATERAL DISLOCATION OF THE ATLAS ON THE AXIS

The displacement is rotatory, the atlas slipping forward on one side and impinging on the articular process below or coming to rest in the intervertebral notch. When the atlas impinges on the articular process and does not slip into the intervertebral notch the head will be turned away from the affected side and the point of the chin will be elevated. A case report of this lesion by Friedman and Tiber [3] contains an excellent illustration of the typical deformity.

The second type, in which the articular process of the atlas falls into the intervertebral notch in front is more serious and is characterized by the head being turned so that the chin is pointed away from the affected side but is depressed instead of elevated.

Immobility of the head is a characteristic of both types and the peculiar position of the head simulates torticollis. However, the relaxation of the muscles of the neck on the side of the lesion together with the taut condition of the muscles of the opposite side of the neck will differentiate. Nodding is somewhat limited but less so than rotation. Limitation of motion is due partly to pain but also by true bony obstruction. The x-ray will visualize the atlanto-axial articulations and these will be seen to be unequal in width. The narrowing of the joint space will be on the affected side. The lateral view will show the anterior displacement of the atlas.

In a normal neck the transverse process of the atlas can be palpated about halfway between the angle of the jaw and the mastoid. If there is rotatory displacement, there will be two abnormal prominences, first from the forward displacement of the dislocated mass of the atlas and the other on the opposite side of the neck, lower down, which is the portion of the axis made more prominent by the slipping back of the atlas. The finger examining in the mouth may feel displacement along the pharyngeal wall.

Speed [4] states that these dislocations do not cause cord compression or death and that they may be reduced by manipulation even after long standing. Scudder [5] believes this to be a common injury but

[3] Friedman, L. J. and Tiber, A. M., Simple rotary luxation of atlas, Am. J. Surg. 19: 104-105, Jan. 1933.
[4] Speed, K., A Textbook of Fractures and Dislocations, Lee & Febiger, pp. 170-200, 1928 edit.
[5] Scudder, C. L., The Treatment of Fractures, Ninth Edit., W. B. Saunders, pp. 90-118 and 691-697, 1922.

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often unrecognized. DaCosta [2] states that a dislocation of the atlas without fracture of the odontoid is extremely rare and Jefferson [1] states that such a dislocation is impossible unless fracture of the odontoid or rupture of the transverse ligament occurs.

Treatment.—Manipulation by the method described by Walton [6] in 1889 is still the preferred manner of accomplishing reduction. The patient is anaesthetized with ether, the head grasped with both hands and rotated slightly to carry the dislocated process forward and "unlock" it. The head is then rocked toward the sound side and somewhat backward and finally the process is replaced by rotation. A fulcrum is furnished by the articular processes of the uninjured side.

Walton advocated the use of no force but later writers agree that the use of Taylor's head traction apparatus will often facilitate reduction. This consists of a device which fits under the patient's chin and occiput and is connected with a broad strap which goes around the operator's waist. This permits the operator to maintain steady traction on the head by leaning backward and allows the hands to be free to support the neck and occiput. The assistant steadies the patient and pulls downward on the shoulders. A Hawley table is desirable, but not necessary.

FRACTURE OF THE ODONTOID PROCESS OF THE AXIS

This lesion may occur with or without dislocation of the atlas and often complicates fractures of the atlas. X-rays taken through the open mouth will show the line of fracture. Osgood and Lund [7] were able to find 56 cases of fractured odontoid reported in the literature up to 1928. Since that time McWhorter [8] reported one case in 1929, Anderson [9] one case in 1932, Kahn and Yglesias [10] reported two cases in 1935, Reich [11] reported one case in 1938, and Kamman [12] and Padula [13] reported one case each in 1939. These cases, together with the case which I am reporting, would seem to make a total of 60 cases of fracture of the odontoid process reported in the literature to date.

Symptoms.—The symptoms will be those of the associated lesion, as previously described under fractures and dislocations of the atlas,

[6] Walton, G. L., Boston M. & S. J. **120**: 277, 1889.

[7] Osgood, R. B., and Lund, C. C., Fractures of odontoid process, New England J. Med. **198**: 61-72, March 1, 1928.

[8] McWhorter, G. L., Fracture of atlas vertebra; report of 3 cases, one with removal of posterior arch for neuralgia; J. Bone & Joint Surg. **11**: 286-291, April 1929.

[9] Anderson, C. B. C., Fracture of odontoid process of axis, J. Roy. Army M. Corps **59**: 371-372, Nov. 1932.

[10] Kahn, E. A., and Yglesias, L., Progressive atlanto-axial dislocation, J. A. M. A. **105**: 348-352, Aug. 3, 1935.

[11] Reich, R. S., Posterior dislocation of first cervical vertebra with fracture of odontoid process, Surgery **3**: 416-420, March 1938.

[12] Kamman, G. R., Recurring atlo-axial dislocation with repeated involvement of the cord and recovery, J. A. M. A. **112**: 2018-2020, May 20, 1939.

[13] Padula, R. D., and Tracey, E. J., Fracture-dislocation of axis and atlas in an infant, J. A. M. A. **112**: 1149-1150, March 25, 1939.

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if the patient survives. However, the symptoms may be so slight that the seriousness of the lesion may not be apparent unless roentgenograms are taken. An early diagnosis is imperative so that immobilization may be carried out before some slight trauma, such as sneezing or shaking the head, causes death.

Prognosis.—The prognosis in cases of injuries to the first two cervical vertebrae, which are complicated by odontoid fracture, is undoubtedly graver than if such a fracture is absent. The mortality in the whole series of reported cases is well above 50 percent, although the outlook has improved markedly since the introduction of radiography.

Treatment.—The treatment consists in immediate immobilization with or without a preliminary period of head traction. Immobilization may be secured by the same methods as mentioned for the treatment of atlas fractures.

BILATERAL ROTATORY DISLOCATION OF THE ATLAS ON THE AXIS

Greeley [14] reported a case of bilateral rotatory dislocation with recovery. In this case there was a rotation to a 90° angle of the atlas on the axis and the patient's chin was over his shoulder. This lesion was reduced by manipulation under ether and made a perfect recovery after 3 weeks' immobilization. Such cases are extremely rare.

BILATERAL (NONROTATORY) DISLOCATION OF THE ATLAS ON THE AXIS

This is a very serious lesion and can only occur if there is a fracture of the odontoid process or rupture of the odontoid ligament. It is a common injury in hanging and usually occurs from some violent trauma. The history is one of serious injury; attempted suicide, neck caught in a noose or pulley belt, or being thrown through the air and landing on the head. As a rule, death is instantaneous. If the patient survives the immediate trauma, neurologic signs are usually absent or of very short duration. There is severe pain in the neck and complete inability to raise or move the head. X-ray pictures taken in the lateral position show forward displacement of the atlas on the axis with or without fracture of the odontoid process. Examination shows marked tenderness of the back of the neck and prominence of the spinous processes beneath the occiput.

Treatment.—Reduction is easy, but there is little to hold the bones in place after reduction. Adequate and prolonged fixation is therefore required. After removal of fixation there is danger of recurrence. Mixter [15] advocates open operation in early cases for the purpose of anchoring the arch of the atlas to the arch and spinous processes of the

[14] Greeley, P. W., Bilateral (90 degrees) rotatory dislocation of atlas upon axis, J. Bone & Joint Surg. 12: 958-962, Oct. 1930.

[15] Mixter, W. J., Dean Lewis Practice of Surgery, W. F. Prior Co., Vol. XII, pp. 1-17.

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axis, using strips of fascia lata for the anchoring stitch. He recommends immobilization for at least 6 months.

Kahn and Yglesias [10] describe a lesion which they believe to be a progressive affair, characterized by a fracture of the odontoid process at its base and loosening of the atlanto-axial ligaments, with the exception of the transverse ligament, for which they advise an open operation, and present two case histories. It is quite evident that their cases were not of the unilateral rotatory type but the bilateral forward dislocation as shown by the position of the head with relation to the vertebrae in the roentgenograms accompanying their paper. They also quoted case histories of other published reports of open operations upon the atlas and axis. Their operation, which they call occipitocervical fusion, is a modification of the Hibbs fusion operation in which bony shelves are turned down from the occipital bone on both sides of the median nuchal crest, a Hibbs fusion done on the second to the fifth lamina, and a graft from the iliac crest placed on each side of the midline starting from the superior nuchal line of the occipital line down to the lamina of the fifth cervical vertebra. Multiple chip grafts were placed around the grafts and the patient immobilized in plaster.

Case Report

L. Q.; age 45 years; single, white male; weight, 165 lbs., height, 69 in.; C. C. C. enrollee and a native of South Carolina; was admitted to the naval hospital, Charleston, S. C., July 8, 1935, with a diagnosis of fracture of the base of the odontoid process with anterior dislocation of the atlas on the axis made after x-ray examination.

Chief complaint.—Pain in the back of the neck and inability to move head.

Present illness.—About 10:00 p. m. on July 5, 1935, he was leaning against a bridge railing which gave way, allowing him to fall head foremost about 18 or 20 feet into water which was about 2 feet deep. On falling, the right side of his head and face struck the water (and sandy bottom) first. He was not unconscious at any time but he immediately noticed pain in the right side of his neck posteriorly and that his head was rotated to the left with depression on the right side and fixed in that position so that no motion of the head was possible. He at first thought that this was due to a "sprain" in the cervical region and remained at camp 3 days before being brought to the hospital for x-rays by his camp physician.

Medical history.—Irrelevant.

Physical examination.—Negative except for deformity of the head, which was rotated to the left and depressed on the right side in fixed position with evident pain in the neck. He presented the typical deformity of a unilateral anterior dislocation of the axis as illustrated in textbooks and in the essays quoted as references. There was evident pain on palpation over the right side of the first and second cervical vertebrae posteriorly. There were no abnormal neurological findings. x-ray revealed anterior dislocation of the atlas upon the axis with a transverse fracture through the base of the odontoid process. A moulded plaster posterior splint was made for temporary immobilization and the next morning he was given ether to the point of complete muscular relaxation and reduction accomplished by a combination of the Walton manipulation and Taylor extension methods.

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Reduction was accomplished easily and it is believed that the relief of muscular spasm by anaesthesia was an important factor. A plaster jacket and helmet was applied to immobilize the head and the correct position. This cast was continued until August 28, 1935 (50 days) and provided adequate immobilization. Lateral x-rays taken through the cast showed correction of the dislocation. On August 28, a mechanical aluminum brace was provided and the cast was removed. The head was then immobilized by the use of this brace, made from illustrations of the Young "Y" brace. This provided immobilization until September 24, when it was removed, after 11 weeks total immobilization.

X-rays made on August 30 showed the odontoid process slightly inclined to the left with what appeared to be some union at the site of fracture. At this time there also was noted a slight separation between the right articulating processes of the second and third cervical vertebrae and some slight absorption of the right inferior articular process of the atlas. The patient was cautioned against sudden jars or blows on the head. His neck motion is fairly good although there was considerable stiffness at first due to prolonged immobilization.

It is believed that the prognosis in this case is good, in spite of the fracture of the odontoid, because of the fact that at no time since his injury has he had any symptoms indicative of spinal cord or medulla injury, and because he was promptly immobilized. From the date of discharge from the hospital (October 1935) until the present time (August 1939) this man has been able to do his work in the C. C. C. camp about like other men there. He states that at times his neck is stiff but at other times he suffers no inconvenience. He has not spent any time in the hospital since his discharge and has lost no time from the injury

SUMMARY

1. A review of the subject of fractures and dislocations involving the atlas and axis, is presented.

2. A case of complete unilateral rotatory dislocation of the atlas upon the axis, complicated by fracture of the odontoid process, with recovery, is presented.

3. Including the above case, there are 65 reported cases of fracture of the odontoid process, and the mortality rate of these cases has been over 50 percent.

FRACTURES OF THE CARPUS

By Commander F. E. Hook, Medical Corps, United States Navy

INTRODUCTION

One gets a fairly accurate idea of the general knowledge existing on carpal fractures at the beginning of the present century by reading Stimpson's text book on "Fractures and Dislocations" published in 1900. The subject is covered in approximately one-half of a page and the opening statement is as follows: "Simple fractures of the carpal bones appear to be rare. Only a few cases have been reported in which the nature of the injury was shown by direct examination, and I have met with only one case in which the diagnosis was made during life."

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With the advent of the roentgen ray it was only natural that carpal fractures should be more frequently recognized. Although much experimental work had been done previous to the work of Hirsch (1914), he is generally given credit for having worked out the mechanism of fractures of the navicular, the most commonly broken bone in this group. Kellogg Speed's excellent monograph on "Traumatic Injuries of the Carpus" (1925), added much to the general knowledge, but still, the true importance of these fractures from the standpoint of disability produced, has been slow in reaching the profession as a whole.

Within the past decade there has developed a marked increase in interest in carpal fractures, and especially in those of the navicular. With this has come better understanding and newer methods of treatment, all of which has removed navicular fractures from what once was a generally bad prognostic group and placed them on a plane with fractures elsewhere in the body. Space does not permit mentioning many of the names of those who have contributed to the subject. Boehler, Schnek, Beck, Berlin, Adams, Murray, Burnett, and Soto-Hall and Haldeman stand out as leaders in this work.

Carpal injuries other than those of the navicular and lunate are uncommon and do not constitute separate clinical entities. Therefore, much of this discussion will be based upon the common navicular fractures. After them in frequency come lesions of the lunate, either fracture or dislocation, or a combination of both, complicated fracture-dislocations between the proximal and distal rows of bones, and finally the rarer lesions of other bones.

FREQUENCY

Key and Conwell report 0.5 percent and Zwerg and Heidemann report 1.3 percent of all fractures as occurring in the navicular. In a study of 123 collected cases of carpal injuries, Bizarro found the navicular to be the seat of fracture in 86 percent of the cases. Statistics (table 1), compiled from the annual reports of the Surgeon General, U. S. Navy, for the years 1933 to 1936, inclusive, show a total of 6,544 original admissions for fractures of all bones. Of these, 175 (2.6 percent) were for carpal fractures of all types and 143 (2.2 percent) for fractures of the navicular, the latter accounting for 81.7 percent of all carpal fractures. As 13 percent of all original fracture admissions were for fractures of more than one bone, these statistics are somewhat misleading. A computation of all of the broken bones in this multiple fracture group would tend to reduce the percentage of carpal fractures somewhat. Table 2 shows the percentage of the various carpal fractures.

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TABLE 1

	1933	1934	1935	1936	Total	Average per year
Average enlisted strength	95,052	96,386	100,846	110,085	402,369	100,592
Original admission all fractures	1,701	1,583	1,452	1,808	6,544	1,638
Patients having multiple fractures	208	184	223	225	840	210 (13%)
Fractures of radius, all types	96	94	116	128	434	108
Sprains of wrist	39	52	47	50	188	47
Carpal fractures, all bones	50	37	35	53	175	44
Navicular fractures	38	31	29	45	143	36
Sick days navicular fractures	1,390	1,301	1,762	2,415	6,868	1,717
Sick days per patient navicular fractures	36.6	42	57	55		47.4
Navicular fractures invalided from service	1	3	2	1	7	

TABLE 2

Carpal fractures, classified	1933	1934	1935	1936	Total	Percent
Navicular	38	31	29	45	143	81.7
Lunate	2	2	2	0	6	3.4
Triangular	3	1	1	3	8	4.6
Pisiform	1	0	0	1	2	1.1
Greater multangular	1	0	0	1	2	1.1
Lesser multangular	1	0	1	0	2	1.1
Capitate	2	1	1	2	6	3.4
Hamate	2	2	1	1	6	3.4
Total	50	37	35	53	175	

According to many writers, navicular fractures occur in the ratio of about 1 to every 10 Colles or kindred fractures. Table 1 shows that there were 434 admissions for fractures of the radius of all types during the same period in which 143 fractures of the navicular occurred. This gives an approximate ratio of 1 navicular fracture to every 3 of the radius. It is unfortunate that these statistics do not show the location of the radial fractures; however, it is unlikely that more than two-thirds were of the Colles type, which would bring the ratio of navicular to Colles fractures down to 1 to 2. To the nonmilitary surgeon who cares for all ages and sexes these figures will be out of keeping.

A fall on the outstretched hand may cause a fracture of any bone in the upper extremity including the clavicle and scapula. When any individual receives such a fall, age is frequently the determining factor as to the type and site of fracture that may occur. Many years ago military surgeons noted the frequency in which fractures of the carpal bones caused disability for military duties. Although there are some hazards inherent in the naval service such as: Falls from hammocks, falls on steel decks, and injuries in handling guns, the chief reason for the frequency of navicular fractures in the service is believed to be age, as the enlisted personnel as a whole is mostly within the age limits where we expect to get fractures of this type. In studying 100 navicular fractures Burnett found that only 6 percent occurred in females. Forty-eight percent of his cases were 20 years of age or under.

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ANATOMY

Certain characteristics of the anatomy of the carpal bones have much to do, not only in determining the type and location of fractures, but also with the healing of these fractures. The greater range of motion in the proximal row requires more extensive cartilaginous surfaces for articulation with the radius and the distal row. This proportionately large joint or cartilaginous surface reduces the area for ligamentous and capsular attachment, thereby lessening the area in which blood supply may reach the bone. This is especially true of the navicular where the supply, which consists of small terminal twigs, enters the bone through the fibers of the collateral radial ligament. In a study of 297 carpal naviculars removed from cadavers, Obletz and Halbstein found that in 13 percent there were no arterial foramina proximal to the constricted midportion or "waist" of the bone. In 20 percent there was a single small arterial foramen at the waist or proximal to it and in 67 percent there were two or more foramina proximal to the waist. The significance of these findings is apparent as most of the navicular fractures occur through the waist of the bone.

MECHANISM

Carpal fractures may be caused by direct or indirect violence. Where direct trauma is the cause the lesion is more apt to be compounded and the fractures are frequently multiple as in crushing, lacerating, or gunshot wounds. Most of these fractures are due to indirect violence such as a fall on the outstretched hand, or by backfiring of a motor while hand cranking. The impact of the falling body weight is transmitted through the hand to the wrist and forearm, forcing the hand into extreme dorsal flexion. As the force is continued the strong carpal ligaments, especially the volar, hold the bones in line and the movable proximal row is angulated into an extended position and subjected to a crushing injury. The navicular, acting as a buffer between the capitate and the distal articulation of the radius, is frequently the seat of fracture. The third metacarpal, being the longest and most important of the metacarpals, takes up the force of the fall and transmits it to the capitate, and then to the navicular. The part of the bone that is compressed depends entirely upon the degree of radial or ulnar flexion at the time. Three types of navicular fractures are commonly described:

1. Avulsion fractures of the tuberosity. These are not common and are caused by traction on the collateral radial ligament when the wrist is forced into strong ulnar flexion.

2. Compression fractures of the body. This is the common type and is produced with the hand in either radial or ulnar flexion and

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90 degrees or more of dorsal flexion. With the navicular lying directly beneath the lower radial articulation the impact of the capitate crushes the spongy part of the bone, causing marked interference with the blood supply.

3. Flexion fractures caused by bending forces. The break in the bone may begin either on the convex or concave side. If the force increases the normal curvature of the bone the fracture line will appear on the convex surface. If the force tends to decrease the normal curvature it will appear on the concave side. These are the simple transverse intra-articular fractures without compression or comminution.

The mechanism of lunate injuries is the same as that of navicular fractures except that the wrist is in more ulnar flexion at the time of impact. Fracture, dislocation, or a combination of both, may occur, and it is not uncommon to have an associated fracture of the navicular. The triangular bone is seldom fractured but may suffer crushing violence in falls and trauma similar to that suffered by the navicular with the hand probably in extreme ulnar flexion. Fractures of the pisiform are usually caused by direct violence as a squeeze of the whole carpus or sudden violence to the palm of the hand. The greater and lesser multangular bones are the least often fractured. The causative agent is probably a fall on the abducted fixed first metacarpal. The capitate is fractured chiefly in accidents where massive force is applied while the hand is in a neutral position. Direct violence is more frequently the cause than indirect violence.

PATHOLOGY

The similarity between navicular fractures and those of the femoral neck has been described; as both are intracapsular, devoid of periosteum, and their proximal fragments are deficient in blood supply. They also respond similarly to both neglect and treatment. In fractures of the tuberosity of the navicular the lesion is extra-articular and there is little tendency toward separation of the fragments. Disturbance of the blood supply to both fragments is minimal and callus forms quickly, bone union resulting even in the absence of immobilization.

In the flexion or bending type of fracture the break is near the middle of the bone and directly across its long axis. The fracture may appear to be incomplete in the initial x-ray films and there is little tendency to displacement of the fragments even when the fracture is complete. Hemarthrosis takes place as the fracture is intra-articular. Some crushing is found in the spongiosa with damage to the blood supply both locally and generally as the nutrient vessels arriving via the periosteum and the nutrient foramina and entering the bone in the ligamentous attachment are torn off. Enough of

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the blood supply to the distal fragment may remain intact to keep it viable. Slow absorption takes place along the fracture and the plane widens. If treatment has been neglected bone absorption continues with pseudarthrosis and cavity formation in the nonviable fragment. This is a slow aseptic necrosis and requires several months to develop.

In the compression fractures the picture is more complicated from the beginning as there is marked crushing of the cancellous portion of the bone and frequently displacement of fragments. The damage to the blood supply is extensive so that the bone may die *en masse*. With this destruction of the blood supply there is little attempt at repair and if immobilization is neglected, allowing constant movement of the fragments, new capillaries will not bridge the fracture lines. The fracture surfaces become eroded and are replaced by fibrous tissue. Cavity formation and pseudarthrosis follow with slow aseptic necrosis. This foreign body produces proliferative irritation in the bones of the wrist with resulting osteo-arthritis deformans. Bone proliferation is particularly noticeable along the radial styloid. Preiser, as early as 1910, wrote on spontaneous fractures of the navicular that followed posttraumatic osteitis. Further investigation of his cases, however, proved that fractures preceded the osteitis. The condition described above is now frequently known as Preiser's disease. Zwerg and Heidemann report that two-thirds of their cases with pseudarthrosis presented more or less osteo-arthritis deformans. Although many different theories have been advanced to account for the frequency of pseudarthrosis in navicular fractures, damage to the blood supply of the bone plus movement appear to be all that is necessary to bring about this condition.

The pathology of crushing fractures of the lunate is similar to that of the navicular, the fragments going on to necrosis and nonunion. The condition known as Kienbock's disease is a slowly progressive osteitis of the lunate, sometimes seen following injuries to the wrist which cause interference with the blood supply. Partial dislocation with spontaneous reposition may be the cause. It is a rarifying osteitis similar to Kummel's disease of the vertebral bodies. There is nothing peculiar about the pathology of fractures of the other carpal bones, as their blood supply is better, they heal quickly, and with little disability.

SYMPTOMS AND SIGNS

A large percentage of patients with navicular fractures come in complaining of what they think is a sprained wrist. There is a history of trauma either recent or old. In old cases, the patient will frequently say that following the injury which occurred some months or years previously, the wrist was sore and lame for 2 or 3 weeks and then cleared up and gave little or no trouble until months or years

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later when gradually increasing disability in the wrist forced him to seek medical attention. Some will give a history of more than one injury so that it may be difficult to decide just which injury caused the fracture. I have seen several patients who sustained fracture and after a few weeks even without immobilization regained good function in the wrist only to have a recurrence of all of their symptoms following a second injury of a trivial nature. Typical of this is the case of a seaman, 21 years of age, who injured his wrist while boxing in October of 1931. The hand was soaked in hot water several times a day for 3 weeks but there was no immobilization. Following this injury, motion in the wrist was not complete and he had some pain on hard work but was able to carry on with his duties. Two years later while walking on a crowded street he struck his extended thumb against another pedestrian. This, he says, sent a pain through his entire body and since that time he has had marked disability. The roentgenogram showed an old compressed navicular fracture with pseudarthrosis.

In the early cases there is some localized swelling over the carpal region. This is always distal to a line drawn between the styloid processes. There is soft edema in the region of the snuffbox but no ecchymosis as is frequently seen in other fractures. Pressure in the snuffbox elicits sharp pain. Motions in the wrist joint are limited and painful, especially those of dorsal flexion and radial flexion.

There is a reduction of the gripping power of the hand which at times may be marked. In the old cases there is frequently marked restriction of all motions of the wrist, and gripping power is lost to such an extent that at times the hand may be practically useless. Pain is almost constant on motion but is relieved by rest; the stiffness, however, remains. The muscles of the hand and forearm atrophy from disuse, and as a whole the picture is one of marked disability. An example of this is the case of a marine captain 43 years of age who fell from a horse 5 years previous to reporting for treatment. At the time of injury he thought his wrist was sprained and he painted it with iodine and wrapped it up but did not see a medical officer. He had some pain on use for about 1 year and then it disappeared until the past year. Since that time the pain has gradually increased along with stiffness. Recently the pain and weakness in the right hand has made it necessary for him to use the left hand in firing the service pistol. Examination shows practically no dorsal, radial, or ulnar flexion and only about 15 degrees of volar flexion, tenderness in the snuffbox, and marked weakness of the grip. The x-ray shows an old comminuted fracture of the right navicular with fragmentation and advanced osteo-arthritis deformans of the wrist.

Sprains of the wrist (table 1) in the naval service are only slightly more common than carpal fractures as over the same period of time

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there were 188 sprains and 175 fractures. Undoubtedly some of these so-called sprains were undiagnosed navicular fractures. A sprain should clear up entirely in 3 to 4 weeks. If at the end of that time symptoms persist and there is tenderness in the snuffbox, one can be fairly certain that a fracture of the navicular exists.

Roentgenograms should be made with the palms downward, the hands in ulnar flexion, and the thumbs closely approximated. The tube should be centered at a point midway between the radial styloids. Lateral views are also made to show displacement of fragments or a possible associated dislocation of the lunate. The mechanism of navicular fractures can be revealed by the x-ray in bending fractures that are incomplete and in compression fractures where there has been marked crushing of the bone. Occasionally the x-ray will fail to show a fracture immediately after injury, where if plates are made again in 3 or 4 weeks the line is plainly seen due to absorption in the fracture plane. This, however, will seldom happen if the original roentgenograms are properly taken and carefully read. Bipartite naviculars are said to occur in about one-half percent of all individuals and this condition should always be kept in mind. In my experience bilateral fractures of the navicular are much more common than bipartite naviculars.

Although fracture of the lunate alone does occur, it is not as common as dislocation of that bone, or a combination of dislocation of the lunate and fracture of the navicular. In fresh dislocations there is swelling of the wrist, pain on motion, and some diminution in hand power. As the dislocation becomes older the swelling subsides but the pain and loss of function increases. Median nerve involvement may be present. The x-ray shows the lunate missing from its usual habitat.

PROGNOSIS

In reviewing notes made at one of our leading orthopaedic clinics 10 years ago I find the following notation:

> One-half of all navicular fractures will result in nonunion, and of this half, 50 percent will require excision of the bone for relief of pain. Excision, however, will not increase the amount of motion in the wrist joint.

The marked advances in the treatment of these fractures in the past few years has entirely changed the picture so that the end results now in recent properly treated fractures, are comparable to those of other bones in the body. Soto-Hall and Haldemann report bone union following immobilization alone in 75 percent of their fresh navicular fractures, while Boehler reports 100 percent cures with the same method of treatment. As long as one year, however, may be required even in fresh fractures to get a complete return of function.

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Any fracture untreated or improperly treated for as long as 3 weeks should be considered as a neglected case and the chances of getting primary union by immobilization alone are not as good as if immobilization had been instituted immediately after the injury. Certainly all untreated cases do not go on to pseudarthrosis and aseptic necrosis, but the percentage that does must run high. In the old neglected cases with pseudarthrosis, and where osteo-arthritic changes have taken place, a complete return to normal function cannot be expected regardless of the type of treatment employed. With proper treatment, however, it is possible to get a useful, painless wrist in a large percentage of the cases. Cure hinges entirely on bone union, and although a patient with pseudarthrosis may have few symptoms at the time, he is always exposed to the danger of developing osteo-arthritis deformans at some later date.

TREATMENT

After what has been said about the anatomy and pathology of these fractures there need be little argument for early, complete, and prolonged immobilization. Uniformity of opinion as to the most favorable position in which to immobilize navicular fractures does not exist. Berlin, by dissecting 60 wrists, demonstrated that a position between 40 and 50 degrees of dorsal flexion and slight radial flexion invariably gave the best approximation of the fragments. For immobilization plaster is preferable to other materials. The cast should be nonpadded and should include the forearm, the palm of the hand, and the thumb, holding the latter in abduction and extension. See figure 1. Proper immobilization of the thumb is indispensible as movement of the thumb involves the long flexor tendon and the abductor pollicis which are closely associated with the navicular. The abductor pollicis brevis originates in the anterior annular ligament and in the tuberosity of the navicular, therefore, movements of abduction of this digit will produce motion in the distal fragment. Immobilization should be continued for from 7 to 12 weeks. If the facture has been a simple linear one, the cast can be removed at the end of 7 weeks for an examination and a check roentgenogram. If tenderness is still present over the snuffbox the chances are that bone union has not occurred. The x-ray usually agrees with the physical findings but it is not infallible. If bone union is found not to be progressing favorably, immobilization is continued for another period of 6 to 8 weeks, after which another check is made. Just how long conservative treatment should be continued is debatable. Soto-Hall and Haldemann say that it is apt to result in failure if 3 weeks have elapsed between the time of the injury and the initiation of treatment, while Schnek and Boehler claim to have cured many cases of nonunion of

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the navicular by continuing immobilization for long periods of time, even up to 6 or 12 months. Burnett thinks if bone union is not in progress after 4 months of conservative treatment, surgery should be resorted to in an effort to prevent osteo-arthritis deformans.

When conservative treatment fails to give the desired bone union, surgery is then to be considered. This may be one of four procedures:

1. Multiple drilling of the bone fragments.
2. Bone grafting or pegging.
3. Fusion with the neighboring carpus.
4. Excision of a fragment or the entire bone.

Drilling of bone fragments in the treatment of nonunion is not new, but as far as the navicular is concerned, it was first recommended by Beck in 1929. The multiple drill holes extending from the viable into the nonviable fragment opens up new channels for the extension of blood vessels. A small stab wound is made over the dorsum of the wrist or in the snuffbox, preferably the latter, through which a 2 mm. diamond pointed drill is passed, and with this several channels are made across the fracture plane into both fragments. This may be done blindly or under the guidance of the fluoroscope. I have had the misfortune of breaking off a drill point in the navicular by striking the fluoroscopic screen against the drill handle. The presence of this metal foreign body buried in the navicular appeared to have no deleterious effects as bony union and normal function resulted.

In 1928 Adams reported the first successful case of bone grafting in the navicular. This was followed by Murray's description of a bone pegging operation. Burnett and Soto-Hall and Haldemann have done much to popularize these operations. The inlay graft is placed through a dorsal incision, while the peg graft is usually inserted through an incision in the snuffbox.

Matti has recently described a new method of treatment which consists of filling both fragments and the space between them with fresh living cancellous bone taken from the greater trochanter. The operation is performed through a radiodorsal longitudinal incision. The fragments are hollowed out with a sharp curette and the cavity packed with cancellous bone just as a dentist fills a tooth. He reports satisfactory results in three cases treated in this manner.

Kellogg Speed, who was formerly a staunch advocate of excision of the navicular for pseudarthrosis, now feels that a fusion of the diseased fragments to the healthy neighboring carpus is preferable to excision. He does this by freshening the adjacent bone surfaces to permit new blood supply from the healthy carpus. This should give relief from pain and considerable restoration of the dead fractured bone. An experience of mine would lead me to believe that the same

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results might be had by drilling from a healthy carpus into the diseased fragments or by bone pegging of a diseased fragment to a healthy carpus. In the case I have reference to a bone peg was inserted through the distal navicular fragment into the capitate instead of the proximal navicular fragment. The patient who previous to operation complained of marked pain and stiffness in the wrist and was unable to work, made a complete functional recovery and now does heavy work without complaint.

Excision of a fragment or the entire bone will be reserved for the fracture dislocations in which reductions cannot be accomplished.

In dislocations of the lunate with or without associated fractures, if seen within the first week or 10 days an attempt at reduction should be made. The Thomas wrench may be useful for this purpose. In the late cases a more satisfactory result will be obtained by excision of the bone than by reduction. This should be done through a volar incision and care taken not to injure the median nerve.

In fractures and dislocations of the other carpal bones reduction should be done when possible and followed by immobilization. Where reduction cannot be accomplished, the dislocated fragments should be surgically removed.

REPORT OF CASES

During a period of 5 years (1932–37), 50 patients were admitted to the naval hospital, San Diego, suffering with navicular fractures. Three of these patients had fractures of both naviculars. The youngest patient was 17 years and the oldest was 42 years of age. The average for the entire group was 24 years.

Of these 50 patients, 45 percent were injured aboard ship and 55 percent while on shore. Forty-eight percent occurred while at work and 52 percent while on liberty or engaged in some form of athletics, the latter accounting for 24 percent of all of the fractures. Falls of all types were responsible for 78 percent of the fractures, while 8 percent were due to falls from hammocks. Eight percent were injured in gunnery accidents. Motor vehicles accounted for only 4 percent of the fractures.

Eighty-one percent of the fractures were located in the body of the bone, 15 percent in the proximal tip, and 4 percent in the tuberosity. A total of 5,141 sick days were recorded in these patients, an average of 116 days (16 weeks) per patient. If converted into working days this would supply a crew for a ship the size of a destroyer for a period of 2 months.

In studying these fractures we have found it convenient to divide them into two groups, namely recent and neglected cases. The period of 3 weeks from the time of injury has been set as the dividing

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line between the two groups. Naturally, this is an entirely arbitrary grouping.

In 27 fractures classed as recent, 25 of the records are available for study. Twenty (80 percent) of these healed with bone union under conservative treatment and returned to duty well. One patient had an associated dislocation of the lunate and after immobilization failed to bring about union, the bone was excised and the patient returned to duty with a good functioning wrist. One patient who had a badly comminuted fracture was invalided from the service on account of a painful wrist after 218 days on the sick list. One patient was discharged from the service on account of expiration of enlistment after having been immobilized for only 6 weeks. He had good function at time but the x-ray showed that bone union had not occurred. One patient with bilateral fractures was allowed to return to duty after only 5 weeks' immobilization. Function was good at that time but bone union according to the x-ray was questionable and the patient now has nonunion of both naviculars. Forty-four percent of these patients reported for treatment within 24 hours of their injury, the remainder ran from 1 day to 3 weeks, 20 percent being in the third week.

In the neglected group there were 25 patients with 26 fractures (one bilateral). Twenty-four of these records (25 fractures) are available for study. The interval between injury and reporting for treatment was from 3 weeks to over 5 years. Fourteen (56 percent) were in the first year, eight (32 percent) in the second year, two (8 percent) in the third year, and one (4 percent) in the sixth year. In this group 11 patients (12 fractures) had conservative treatment (immobilization) alone and 13 had surgery of some type. Bone union occurred in only one patient treated conservatively. This fracture was of 3 months' duration. Six (24 percent) were disabled to the extent that they had to be invalided from the service. Surgery consisted of drilling of the fragments in 7 fractures, drilling followed later by bone pegging in 2 patients, excision of the proximal fragment in 2 patients, and excision of the entire navicular in 2 patients. Bone union followed drilling in 4 patients, was questionable in one, and 4 resulted in nonunion. Two of these failures were followed by bone grafts. One graft was completely absorbed and nonunion and disability persisted, while the patient in whom the bone peg was placed through the distal navicular fragment into the capitate has an excellent functional result. In the 4 patients in which excision was done, the 2 that had only the proximal fragment removed returned to duty with useful wrists, while the 2 that had excision of the entire bone were invalided from the service.

In combining the two groups we find that 50 percent had demonstrable bone union and returned to duty well. Thirty-six percent returned to duty with a slight degree of disability or with a condition

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that might be expected to give trouble at some future time. Fourteen percent had sufficient disability to cause them to be unfit for naval service. These results are far from ideal. Failure to get bone union occurred chiefly in those patients seen in the early part of this period reported upon. At that time immobilization was not kept up for a sufficiently long period of time and many of the old cases with pseudarthrosis, but with few symptoms, were allowed to return to duty rather than insisting that they go to surgery. With our present knowledge on the subject these mistakes would not be repeated.

CONCLUSIONS

1. Fractures of the carpal navicular are of common occurrence in young men.
2. The diagnosis is frequently not made within sufficient time after the injury to obtain for the patient the maximum benefit from treatment.
3. The diagnosis of sprained wrist should be made only after fracture of the navicular has been absolutely disproven.
4. Properly treated, recent fractures of the navicular result in a high percentage of cures (75 to 100 percent.)
5. Improperly and untreated fractures of the navicular frequently result in marked disability of the wrist, which any type of treatment cannot completely alleviate.
6. Cure hinges entirely on bone union and any patient possessing an old fracture of the navicular with nonunion has a potential crippling lesion of that wrist.

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TREATMENT OF MALAR AND ZYGOMATIC FRACTURES [1]

By Lieutenant Commander Frank A. Richison, Dental Corps, United States Navy

In this era of speed the majority of facial injuries are the result of transportation accidents and since the malar bone is quite prominent in the facial contour, it, along with the zygoma, is very often found in the list of casualties.

The skeleton of the face, consisting of bone, cartilage, and teeth, is blended into a more or less harmonious and functional unit Any break in the continuity of this framework of bone, produces a deformity with resultant physical and mental suffering, and the end result of an injury to the face is dependent upon the early and proper care to correct this deformity. Let me repeat the above statement, "the end result of an accident, causing a facial deformity, is dependent upon the early and proper care to correct that deformity." This cannot be overemphasized.

The general rule is that a person receiving facial injuries from an accident usually has other complications, and since obviously the life of the patient is of the utmost importance, the need for prompt reduction and treatment of the facial injury is often overlooked. Aufderheide states, "we have all seen many patients lie around hospitals from 1 to 8 weeks without attention being given to the fractures, with which we are dealing, namely facial." He then adds his plea for early care of these fractures.

Kazanjian states that fractures should be reduced and immobilized as soon as possible to facilitate ease of reduction, hasten healing, and prevent spread of infection. He says that, since bones form the framework of the face, a slight distortion of their position is bound to produce changes in the facial contour, so if early adequate means

[1] From the naval hospital, San Diego, California.

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FIGURE 1.—PLASTER CASTS FOR FRACTURE OF CARPUS.
The upper cast illustrates improper immobilization of the thumb.

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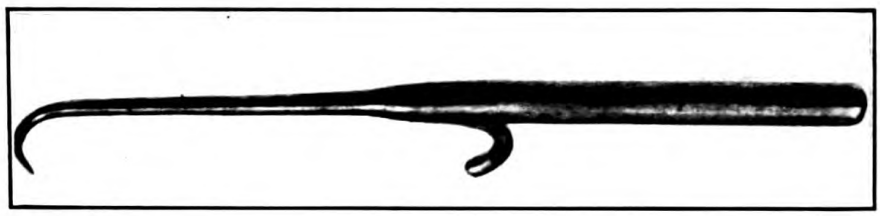


FIGURE 2.—AUTHOR'S INSTRUMENT FOR REDUCING MALAR AND ZYGOMATIC FRACTURES.

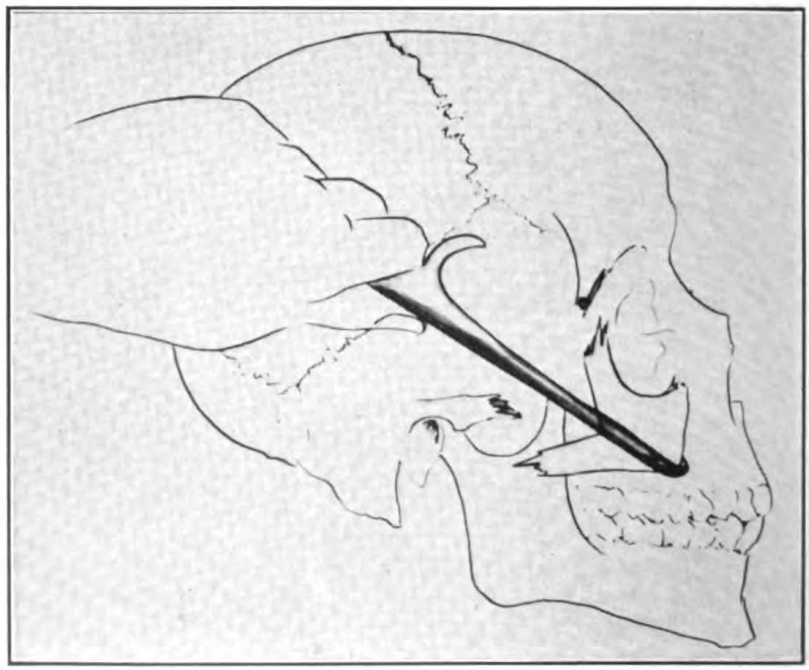


FIGURE 3.—ILLUSTRATES METHOD OF REDUCTION OF FRACTURE.

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are not employed to reduce the displacement, there is likely to be a permanent deformity.

At first, the disrupted parts are freely movable but in 5 or 6 days a fibrous union forms and they can seldom be restored completely, or if so, only after exerting considerable force. The broken surfaces may become altered to such an extent that absolute coadaptation is impossible.

Since bones of the upper face are well nourished by an abundant supply of blood, the fragments will reunite rapidly, but the loss of even a small piece of bone will leave a noticeable deformity so that under no circumstances then should a large amount of bone be removed, or allowed to be lost from delayed or lack of treatment.

So far, we have mentioned the need for early reduction of facial fractures in general. Now, let us consider the fractures of the malar and zygoma bones in particular.

The malar bone is prominently exposed to violence on account of its position in the facial contour, but its flat surface, thick body, and four supporting processes give it great strength. Of the four processes the zygomatic is its strongest support.

Todd examined 467 skulls and found 38 or 8.1 percent of these had fractures of the malar or zygoma. The fracture may involve the body of the malar alone, which is rare, and presents a depression or linear crack. Suture lines connecting the neighboring bones may be disrupted or opened, dislocating the bone inward, downward, or backward. Divided malar bones have been found in at least a dozen different races, but are found most often in the Japanese, about 7 percent. This divided bone has received the name *Os japonicum*. It is well to keep this phenomenon in mind when examining for fractures in the body of the malar.

The zygoma may in turn be fractured alone, disrupted at the malar suture or at the temporal suture.

Since direct violence is the general cause of fractures of these two bones, other bones may also be involved from the same blow. The anterior wall of the antrum may be driven in, alveolar process broken, palatal suture separated or the malar driven downward and impacted into the maxilla.

As previously stated, fractures of the malar rarely occur in the body of the bone but usually at the site of the sutures of the proximating bones, causing displacement either downward and backward or downward and inward. When the bone is displaced downward and inward there is a depression of the cheek below the outer canthus of the eye and a bulging below this abnormality. When the displacement is downward and backward there is a depression of the outer half of the inferior orbital rim and a bulging of the zygomatic arch. Anaesthesia of the lower eyelid, upper lip and nose is common, due to

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pressure on the infra-orbital nerve. It is well to remember that swelling and extravasation of blood can produce the same symptoms. If the fragments are only slightly displaced and there is no nerve pressure, no treatment is essentially indicated, for there will be no disfiguration of the facial contour as the soft tissues will conceal the defect.

In fractures of the malar and zygoma the function of the mandible is seldom interfered with, but pain is often present due to the closeness of the origin of the masseter muscle. The fracture of the zygoma may actually involve the muscle itself and produce a trismus.

If, as most commonly is the case, violent force is applied to the prominence of the cheek, the malar bone will be more or less driven into the antrum and at the same time there may be extensive radiating fractures. The resultant hemorrhage into the antrum is usually self limiting and rarely requires removal as it liquefies and drains, but infections of the antrum may occur. If one of these radiating fracture lines runs through the orbits, the whole bony framework of the face will sag, as it is then supported only by the soft tissues.

The salient symptoms and signs of fractures are:

1. *Pain.*—Pain is usually aggravated by slight movement of the injured part. It is often felt at the site of the facture when distant part of the bone is handled.

2. *Disability of the part.*

3. *Swelling.*—This is due to extravasated blood and serum from torn vessels and inflammatory reaction.

4. *Tenderness.*

5. *Discoloration* of skin due to effused blood reaching the surface. In deep fractures the discoloration may not appear on the surface for several days.

6. *Deformity* is usually present, due, primarily, to the force and direction of the force causing displacement of the fragments. Secondarily, to contraction of the muscles attached to the fragments.

7. *Abnormal mobility.*

8. *Crepitus.*—This is produced by the rubbing of fractured surfaces upon each other. The willful manipulation of the fragments to cause crepitus should be avoided.

9. All fractures should be confirmed by x-ray negatives.

Even though the malar is subcutaneous, it is difficult to palpate, because it merges into the neighboring bones and edema may make it almost impossible to palpate a displacement or fracture. Cold compresses may, of course, be applied to reduce the swelling. A slight depression or displacement may be overlooked unless extreme care is used in the examination.

In examining for fractures of the malar or zygoma, it is best to have the patient in a semiprone position and stand behind him, simulta-

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neously comparing the right and left side of the face digitally and visually. Outline the lower rim of the orbits, borders of the malars and zygomas with the finger tips. The lower border of the malar and zygoma may be examined by hooking the fingertips under it and traveling the entire length of these two bones. Any deformity, depression, or mobility with or without crepitus are salient diagnostic points. Often the swelling about the orbit may obscure the findings for a day or two, but any definite depression in the inferior border of the orbit immediately suggests a displacement of the malar bone downward and backward. Overlapping fragments produce a palpable ridge. Any definite tenderness that can be produced at a point by distant pressure is always suggestive of a fracture at the point of pain. As previously stated, x-ray negatives are prime requisites in all examinations for fractures.

Completing the thorough examination of the face, the dental arches and palate should be inspected to determine whether the injury has also caused a separation of the palatal suture or fracture of the upper alveolar process. Any impingement or bruise of the superior maxillary or infra-orbital nerve will produce pain or anaesthesia of the face, lip, or teeth corresponding to the distribution of that nerve.

When the examination and x-ray study have been completed, the location and extent of the fracture determined, then the treatment procedure must be devised.

Treatment consists of:

1. Reduction of fracture or fractures.
2. Fixation of the fragments.
3. Care of the tissues.

Treatment of malar and zygoma fractures have some favorable points in that, these fractures permit better drainage by gravity, and, the muscle attachments do not counteract the force used in treatment, as they do in the mandible fractures.

Gill uses a large towel forcep, elevating the fracture by forcing the points through the skin and grasping the fragments, applying traction in the required direction.

Shea, inserts a Ritter sound in to the antrum through the nose and applies force to move the fragments into place.

Straith, passes a trocar or heavy curved instrument through the mucous membrane, distal to the upper third molar and beneath the malar bone, behind the maxilla. Upward pressure usually suffices to elevate the fragments sufficiently, but if the elevation is not maintained, the antrum may be packed with iodoform gauze, or the fragments may be wired into place through holes drilled at the frontal attachment, as advocated by Gill. The latter method necessitates an open reduction.

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Gillies makes a curved incision above and in front of the ear within the hair line. The temporal fascia is incised and a long flat elevator is passed downward and forward over the temporal muscle, engaging the internal surface of the fragments, exerting pressure by prying in the direction required to approximate the fractured ends.

In cases of considerable comminution, an approach may be made through a window into the antrum in the canine fossa and pressure applied by an instrument or gloved finger, molding the fragments externally with the other hand. This method, may also be used for reducing a downward and backward fracture of the malar.

There have been 17 cases of fractured malars and zygomas admitted to this hospital during the last 12 months. Practically all these fractures have been reduced extra-orally, by means of traction produced by use of a sturdy, hooked, sharp pointed instrument. See figure 2. The point is forced through the skin and tissues extra-orally and the fragment engaged by the point. See figure 3. The insertion leaves no facial scar or blemish. Pressure is applied in the direction necessary to approximate the fractured ends, checking their position by palpation along the inferior border of the orbit, zygomatic arch and frontal process. After reduction, a recheck is made by x-ray negatives. By this method, the field of operation can be kept sterile and is not exposed to subsequent infection, as is the case when the reduction is made by any intra-oral method. There is small danger of damage to the facial nerve or blood vessels.

There is little tendency for the deformity to reoccur after once corrected, but pressure to the part should be avoided for 2 or 3 weeks until firm union occurs.

In cases of deep impactions of the malar into the maxilla, they should be broken up with a small sharp chisel, the fragments approximated by traction applied with a sharp pointed hooked instrument engaged into the various portions of the bone involved, molded into contour by pressure from the external surface. Unless the bones are extensively shattered, there is small chance for the deformity to reoccur as the fragments reunite with greater frequency and speed than in the mandible.

Facial deformities caused by union of overlapping edges producing a prominence, may be removed by leveling off the ridge with chisels and files to correct the contour.

These cases are by no means so simple and easy of reduction as it would seem from hearing or reading about them. Many complications may and ofttimes do arise, in which the surgeon, roentgenologist, rhinologist, and prosthodontist should be consulted. There are very few men who are so versed and skilled that they can carry the whole burden of these cases unaided. Since the service and advice of the above specialists can be had for the asking, it behooves us to

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consult with them, giving heed to their advice and profiting from their suggestions and services.

SUMMARY

The number of facial fractures is rapidly increasing, due to accidents from the excessive speed of our transportation systems.

The fractures, when presenting deformities of the facial contour or nerve pressure, should be treated as soon as possible, to facilitate reduction and obtain the desired esthetic results.

Many methods are in use for the reduction of these disfigurations. The method does not matter particularly. Each should use the method that brings the best results in his hands. We prefer the hook method used extra-orally, rather than the intra-oral methods, thus avoiding the contamination of the field by oral secretions.

Open reductions should be avoided whenever possible and thus eliminate the resultant scar or blemish on the face.

Lastly, the dental officer should freely consult the surgeon, roentgenologist, rhinologist, and prosthodontist, as there may be and are complications arising which call for the teamwork of all these services.

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LUMBAR SYMPATHECTOMY

FOR VASOSPASTIC DISORDERS OF THE LOWER EXTREMITIES WITH CASE REPORTS

By Lieutenant Guy E. Stahr, Medical Corps, United States Navy

The development of a physiologic understanding of the functions of the autonomic nervous system has given rise to the surgical approach to the problems of a number of types of peripheral vascular disturbances of neurogenic origin.

Since surgical procedures have been instituted in suitable cases of this nature, there has been a rather rapid adoption of surgery for more and more cases which previously would have received little attention, consideration, or relief.

Many of the early articles and cases reported in the literature have tended to be overenthusiastic and undercritical, but more recently surgeons in regarding every case of sympathectomy as somewhat of

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a physiologic experiment have contributed greatly to practical understanding of sound surgical principles and calm evaluation of operative results.

The autonomic nervous system controls or regulates all innervation of unstriated muscle. It is composed of two opposing components, the craniosacral or parasympathetic system and the thoracolumbar or sympathetic system. The craniosacral system is given off from the brain stem and the sacral segments, while the thoracolumbar system leaves the spinal cord only between the first thoracic and second lumbar segments.

The sympathetic trunk is composed of the ganglia and nerve fibers of the sympathetic system of the cervicothoracic and thoracolumbar areas usually superior, middle and inferior cervical ganglia, 12 dorsal ganglia and 4 lumbar, and lying to either side of the vertebral column. White and gray rami communicantes from the anterior and posterior horns of the cord pass to the trunk ganglia in the anterior and posterior spinal nerve roots from the first thoracic to the second and third lumbar nerves, inclusive.

The efferent impulses of central origin to the involuntary musculature of the blood vessels and skin of the lower extremities must therefore be distributed from the second, third, and probably fourth, lumbar ganglia to the mixed peripheral nerves.

Normally the arteries are constantly varying in caliber for the maintenance of homeostasis, and the autonomic nervous system constitutes the mechanism by which such changes in caliber are regulated.

In certain pathological conditions autonomic control is thrown out of balance with a resultant state of chronic vasospasm or vasodilatation occurring. Chronic vasospasm is best exemplified in Raynaud's disease and acrocyanosis. Vasospasm is frequently a contributing factor in thrombo-angiitis obliterans, causalgia, and in the chronic rheumatoid form of polyarthritis.

It is therefore obvious that severance of the efferent sympathetic pathway to the involved parts should relieve vasospasm, particularly that of Raynaud's. Reports in general show marked success in sympathectomy for Raynaud's when the disease has involved the lower extremities only, whereas there has been far less success of a permanent nature from sympathetic denervation of the arms. Sympathetic ganglionectomy has been of considerable value in many cases of Buerger's disease which showed a favorable vasodilator response in preoperative tests, by relieving the pain.

Case Reports

Case I.—C. D.; 1st Sgt., U. S. F. M. C. R.; admitted October 8, 1937.

Chief complaint at admission.—Pains and numbness in toes and feet, more marked in right.

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Past history.—Usual childhood diseases uncomplicated. Had 17 years enlisted service in U. S. M. C. being discharged from active service 1936. During service had chancroid penis, 1922; G. C. infection urethra 1930; and submucous resection 1929. Denies syphilis. General health was always apparently normal. Married twice, one child, second wife, always heavy smoker, alcohol used moderately.

Present illness.—In September 1936 there was onset of sensation of numbness at ends of the toes, both feet. Numbness seemed to occur at irregular intervals but at times endured for an entire day. Accompanying the numbness was a feeling of coldness of toes and feet with a soddenness from excessive sweating which occurred at times. Condition seemed to become more noticeable during 1937 and patient noticed tingling pains in toes and feet occurring more frequently. A degree of numbness and coldness of feet and toes seemed to be almost constantly present and the toes and feet usually appeared somewhat reddish-blue in color regardless of dependency or elevation. Being off feet and in bed for periods of time seemed to relieve the symptoms. Prior to admission patient related he had remained in bed for 10 days because he felt unable to walk.

Physical examination.—Age 35 years, weight 130 pounds, height 69 inches. Patient appeared poorly nourished and rather poorly developed. Only significant findings are reported. There was a scar on the corona of penis.

The reflexes were somewhat hyperactive although equal and there was a very marked tremor of hands and fingers. In general, patient was apprehensive, hypersensitive, emotional, and excitable.

Both feet showed a dusky cyanosis, coldness, and hyperidrosis. Pulses were palpable in both dorsalis pedis and posterior tibial vessels although not strongly. Elevation of feet past horizontal did not produce any appreciable change in the symmetrical discoloration.

Bed rest observation, laboratory and special studies were carried out.

Blood pressure checks of all extremities showed no inconsistencies from normal variations. Urinalysis, Mosenthal, and concentration tests were within normal limits.

Blood Kahn, spinal fluid Kahn, Pandy, and colloidal gold tests were all negative.

RBC, 4,000,000; hgb, 80 percent; WBC 6,000; differential, normal.

Blood sugar, 85 mgms.; chlorides, 386 mgms.; calcium, 15.2 mgms.

X-ray examination of feet and legs was negative except for some evidence of calcium deposit in walls of vessels of right foot. ECG showed normal tracing.

Therapeutically, hyperemic measures gave no relief. Foreign protein using typhoid vaccine produced some relief of symptoms and evidence of vasodilation.

The use of acetylcholine gave some symptomatic relief.

It was felt that the condition was definitely a vasospastic disorder of Raynaud's type although of moderate degree. As conservative treatment had not benefited the condition a bilateral lumbar ganglionectomy of the second, third, and fourth lumbar sympathetic ganglia by the transperitoneal method was performed on November 15, 1937.

There was immediate response to operation. The feet became warm, dry, of normal color and pain subsided. The arterial pulses became stronger. Patient had an uneventful recovery from operation and was discharged free of signs or symptoms on December 22, 1937. He has had no recurrence in the 9 months since operation.

Case 2.—W. S.; VAP; admitted October 8, 1937.

Chief complaint.—Severe pain in left foot and left great toe and inability to walk without cramping pain in left leg.

Past history.—American born, one-half Jewish extraction, no unusual diseases, trauma or operations in childhood. Had high school education, completed 1917. Served in U. S. N. from 1917 to 1921 and had no illnesses or disabilities. Usual

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occupation was sign painting. Married twice with children by each wife. Has always been of moderate habits, smoked cigarettes for 20 years and always used alcohol sparingly. Has never had syphilis.

Present illness.—In early 1936 there was onset of cramping pains in left leg which appeared after moderate walking. Condition progressed rather rapidly into a definite claudication. Dependent rubor with elevation ischemia, coldness, and absence of pulses in the left dorsalis pedis and posterior tibial arteries were observed. Conservative treatment with removal of tonsils and dental foci were of some benefit and diagnosis of Buerger's disease was established. During July 1937 the condition became disabling, due to pain in left leg, foot and great toe which was extremely severe, and patient became unable to walk due to pain. Rest, elevation, heat, position, etc., afforded no relief, and strong sedatives were necessary.

Physical examination.—Age 37; weight 136 pounds; height 67 inches; fairly well developed and nourished, with appearance of pain and discomfort. General examination essentially negative except for lower extremities.

The left foot and ankle were a dusky red deepening into the toes, in dependent position or at the horizontal. Upon elevation past horizontal, a rather rapid ischemia ensued. The left foot and leg were palpably cold although moist. A total absence of left dorsalis pedis and posterior tibial pulses was noted. Skin over the toes and sole of the left foot appeared to be scaling. Slight rubor was observed in right foot on dependency but no actual ischemia appeared on elevation. The right foot was warm and arterial pulses were present.

All laboratory and x-ray studies were essentially negative. Under bed rest, elevation, heat, physical therapy, exercises (Buerger's), heavy sedatives and anodynes alone gave any relief of the subjective pain. Acetylcholine injections, however, gave temporary relief. No progress appeared in time, and the continued pain was believed to warrant surgical interference since temporary relief was gained by acetylcholine. A left resection of the second, third, and fourth lumbar sympathetic ganglia and the communicantes by the transperitoneal method was performed on November 15, 1937.

Recovery from operation was uneventful. The foot became much warmer, and the dependent rubor much less. There was no return of the absent arterial pulses. A disability was resultant in the left leg and ankle from disuse atrophy of the calf muscles and joint stiffness. Patient could not be induced to actively use left leg at time of discharge on January 12, 1938. Stiffness of left ankle and toe joints, disuse atrophy of calf muscles, and pain to pressure on great toe, did not improve. However, the spontaneous pain which was present almost continuously prior to the left lumbar ganglionectomy was entirely relieved following the operation.

On July 4, 1938, a small black spot appeared on the lateral margin of left great toe. It became larger, quite tender,and showed a slight discharge of pus. Due to spreading cellulitis around the trophic lesion, patient returned to hospital on July 7.

Examination then showed toes of left foot to be bluish-red on dependent position with ischemia appearing immediately upon elevation, and constant coldness of the extremity present. The left dorsalis pedis and posterior tibial arteries were pulseless. Acute cellulitis of left great toe involving dorso-lateral aspect with a central blackish slough was noted. Spontaneous pain was not present although the toe was acutely tender to palpation.

The left ankle and toe joints showed fibrous ankylosis and extreme disuse atrophy of calf muscles.

Conservative treatment consisting of wet dressings, irrigations, topical applications in conjunction with elevation and heat improved the cellulitis over a period of

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3 weeks. The infection then began to spread and tenderness of entire foot became more marked. Spontaneous pain was not manifested.

Due to the dangerous development of trophism and the hopeless disability of left leg and foot, amputation at the lower third left femur was performed on August 2.

At operation a very marked obliterative endarteritis of the femoral artery was noted. Very slow healing of the amputation stump due to mild infection and poor circulatory function followed operation.

On November 15 amputation stump was well healed and patient was discharged from further hospitalization with the recommendation to wait a further period of 3 months before fitting and procurement of an artificial leg.

On July 1, 1939, patient had become adapted to use of artificial leg over a period of 3 months use and no stump trouble had been present. He stated that the relief from spontaneous pain, for the period of 7 months, afforded him by lumbar sympathectomy, was well worth while even though the end result in his case was high amputation.

Case 3.—F. C. J. H.; VAP; admitted April 22, 1938.

Chief complaint.—Numbness, coldness, sweating, discoloration and dermatitis of both feet.

Past history.—Usual diseases of childhood uncomplicated. No traumata or operations. Had 10 years of enlisted service in U. S. N. from 1925 to 1935 with general good health during that time. No venereal disease or syphilis. Had recurring attacks of trichophytosis of feet and toes from 1931 to 1935 usually treated by topical fungicides. Has been employed as house painter for past 3 years. Habits have been normal and moderate. Used tobacco for many years but not excessively. Has never had frostbite.

Present illness.—In 1935 following discharge from naval service, he first noticed attacks of numbness of toes which extended backward into soles of feet. These attacks were of short duration and occurred at no particular times. After a few months, the attacks of numbness were accompanied by sensations of coldness, and he noticed that his toes and the dorsal surfaces of feet appeared bluish in color. The attacks of coldness, numbness and cyanosis appeared from no apparent cause and were not affected by position, temperature, activity or rest. The sensations and discoloration appeared to be symmetrical and would spontaneously disappear without apparent reason. He tried hot and cold water foot baths to see if the sensations would clear up, and he frequently rubbed the feet when they felt numb and cold, but these actions never seemed to produce any immediate effect or change.

In February 1938 attacks of numbness, cyanosis, and coldness seemed to be almost constant, and he noticed that the feet would be unusually moist from sweating. At this time, tingling sensations "As if walking on fine pebbles" began to occur in the toes and soles. He would oftentimes go to bed with feet feeling almost natural, and although having adequate covering, awaken with numb, cold, clammy, and cyanotic feet, sometimes followed by tingling sensations. There had been no leg pains, cramps, or claudication, and there was no critical temperature at which attacks occurred. The condition had progressed very little since its onset in 1935, except for appearance of sweating and tingling. No appreciable difference was noted in the right or left foot sensations.

Physical examination.—Age 43, weight 170 pounds, height 68 inches, well developed and nourished and not apparently ill. The teeth were in need of repair of caries, and external hemorrhoids were present. Both feet and all toes showed a symmetrical bluish discoloration extending to just above the ankles when in dependent position. The discoloration lessened slightly on elevation. The toes

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and feet were palpably cold and clammy. A mild scleroderma around great toes and heels was present. The arterial pulses of the dorsalis pedis and posterior tibial vessels were present and equal on both sides.

Blood pressure studies of all extremities were of normal variations. Laboratory studies of urine, blood cells, serology, and chemistry were of normal limits. Fundi of the eyes were normal. X-ray studies of extremities showed no pathology or calcification of vessel walls.

Bed rest observation with elevation and heat showed little change occurring. At times, a less degree of cyanosis was noted, and the feet were palpably warm at these times. A condition of moderate Raynaud's type of vasospasm was thought to be present, and a bilateral lumbar ganglionectomy of the second, third, and fourth lumbar sympathetic ganglia by the transperitoneal method was performed on June 23, 1938. Immediately following spinal anesthesia the feet became warm and dry, and since operation there have been no symptoms of numbness, coldness, sweating, or tingling. Recovery from operative procedure was uneventful and uncomplicated. While no actual cyanosis has been noted, a faint brownish pigmentation of skin from above ankles and over dorsum of feet persisted. Arterial pulsations of the dorsalis pedis and posterior tibials appeared to be unchanged. Patient has been highly pleased at the cessation of symptoms.

Case 4.—J. J. A.; Cpl., U. S. M. C.; admitted April 25, 1938.

Chief complaint.—Attacks of coldness, sweating, numbness, cyanosis of feet and pains from ankles to knees, both legs.

Past history.—Patient had no recognized diseases during childhood and no operations or traumata. He enlisted as a marine in 1927 and had malaria fever in Nicaragua, 1928, with four recurrences during that year. He had a submucous resection and tonsillectomy in 1930 and appendectomy in 1935. He denied history of venereal disease. Habits in general have been normal, used alcohol and tobacco only occasionally. He never married.

Present illness.—From 1929 when he left the Tropics patient experienced attacks of coldness, hyperidrosis, and cyanosis of both feet. A moderate degree of numbness of the toes was present. The legs and knees felt tired and rather weak quite frequently. Attacks of these sensations occurred at irregular intervals, lasted for varying times and varied in intensity from mild to marked degree.

From 1932 the attacks of numbness, cyanosis, sweating, and coldness occurred with greater frequency and several medical examinations failed to recognize any pathological state or to offer any therapeutic measures for subjective relief. Patient stated that he had less complaints of his feet during rainy or cloudy weather, but the feet were considerably worse during two winters spent in Shanghai, China. He always felt less occurrence of symptoms when walking or standing, and found that position changes of dependency or elevation produced no appreciable changes in the feelings of the feet.

During the winter and early spring of 1938 the numbness and coldness of the feet seemed more intense than ever before, and at times, "feet felt half frozen." Sweating of feet was so pronounced that a change of socks was made three and four times a day. The toes and dorsum of the feet appeared constantly bluish in color. Pains in the knees radiating down the legs were felt, and transitory pains were experienced in the low back and shoulders at times.

Physical examination.—Age 29, weight 156 pounds, height 67 inches. Well developed and nourished, ambulatory and not apparently ill or in discomfort. Only significant findings are reported. Deformity acquired, bridge of nose. Tonsils absent. Abdomen normal except small scar of appendectomy. Reflexes present, active, and equal. Small superficial varicosities of anterior legs noted.

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Spine and joints showed no abnormalities. Both feet showed a symmetrical cyanosis of moderate degree from the toes to middorsum of feet. The feet were palpably cold and excessively moist. Good pulsation was present in the dorsalis pedis and posterior tibial arteries bilaterally. Skin between the toes appeared whitened, thickened, macerated, and peeling. No disturbance of epicritic sensations of toes was found.

Laboratory studies showed normal findings. Special examinations of teeth, prostate, sinuses were negative for foci of infection.

X-ray studies were negative for bone or joint pathology and there was no visible calcification of vessel walls in extremities.

Special neurological examination was essentially negative.

Trendelenburg and Perthes' tests of lower extremities were negative, and the small superficial varices of legs were treated by sclerosing solution injection.

A period of bed rest, physical therapy, and position therapy produced no appreciable changes in the attacks of numbness, coldness, hyperidrosis, and discoloration of the feet. A condition of chronic vasospastic origin of the Raynaud's type was believed to be present. Lumbar sympathectomy with resection of the right and left second, third, and fourth lumbar sympathetic ganglia by transperitoneal abdominal method was performed on May 31, 1938.

The feet immediately became warm and dry and returned to normal color. The sensations of numbness completely subsided. There was uncomplicated and uneventful recovery from the operation. Eight weeks after operation, patient performed his usual duties with complete subsidence of all preoperative symptoms and signs, and he stated that his feet feel better than at any time during the past 10 years.

CONCLUSIONS

Four cases of peripheral vascular disease have been presented in which lumbar sympathectomy was performed for the relief of symptoms in the lower extremities.

Three of the cases were definitely of vasospastic neurogenic origin and in being limited to the lower extremities coincide with the accepted idea that lumbar sympathectomy is very efficacious in its application to these cases.

One of the cases, while definitely a thrombo-angiitis obliterans of one leg, demonstrates the vasospastic factor which may be present in these cases, insofar as a relief of pain followed lumbar sympathectomy on the affected side probably due to relief of vasospasm which produced an improved collateral circulation.

The three cases of strictly vasospastic neurogenic disturbance have been referred to as being of the Raynaud's type, inasmuch as no one of these cases was classical in entirety, yet each had the cardinal points of cyanosis of varying degree, sensations of numbness and coldness, pulsation in the peripheral arteries, and a hyperfunction of the sweat glands.

It is suggested that the term "Vasospastic Disorder of Raynaud's Type" could be applied to a small group of conditions which have heretofore passed from hand to hand under varying titles, due to hesi-

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tancy of the examiners to definitely state "Raynaud's" for lack of some classical features.

Thus, if a definite terminology be established or decided upon early, it is likely that the efficacious surgical procedure, which has usually been the last resort, would move into the picture much sooner and supplant the many and useless measures so commonly utilized while fumbling for a clear-cut, classical diagnosis, before instituting a surgical measure of proven merit.

RECENT ADVANCES IN BLOOD TRANSFUSION

By Lieutenant Commander E. P. Kunkel, Medical Corps, United States Navy

INTRODUCTION

Blood is an indispensable therapeutic agent; a supply for transfusion should be readily available wherever the sick and injured are treated. During the past 25 years, the literature on blood transfusion has been voluminous. In recent years new developments of particular interest have included the use of cadaver blood for transfusion by the Russians, the establishing of so-termed "blood banks" in some of the larger hospitals in this country and in England, and the extensive use of preserved blood by the Spanish Government in the recent civil war.

The development of blood transfusion is one of the most fascinating chapters in medical history. It is generally assumed that the history of blood transfusion dates from the discovery of the circulation of the blood by Harvey in 1616.[1] Following this discovery, experiments were begun on the infusion of various substances into the blood stream and also the transferring of blood.

It is of interest to note that blood transfusions during this early period were given to restore youth to the senile, reason to the insane, and for severe systemic diseases. Ignorance of aspepsis, of coagulation of blood groups, and of incompatibility resulted in many severe and fatal reactions. Civil and ecclesiastical pressure was brought to bear on the profession with the result that there was a gradual death of interest in blood transfusion for almost 150 years.

The most important discovery in the history of blood transfusion was in 1900 when Landsteiner discovered that the human blood contained iso-agglutinins, capable of agglutinating other human red-blood cells.

[1] Garrison, F. H.: History of Medicine, 4th edit. 271, Philadelphia: W. B. Saunders Co., 1928.

Hollingsworth, M. W., Blood transfusion by Richard Lower in 1665, Ann. M. History, 10: 213-225, Sept. 1928.

Zimmerman, L. M., and Howell, K. M., History of blood transfusion, Ann. M. Hist., 4: 415-433, Sept. 1932.

Cochran, G. G. J., A Brief Outline of the History of Blood Transfusion. Brooklyn Hospital Journal, 1: 52, Jan. 1939.

DeBakey, M., and Honold, E., Blood transfusion, Internat. M. Digest, 33: 301-313, Nov. 1938.

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Coagulation of blood presented the chief difficulty of transfusion during this era. To overcome this difficulty, Carrell in 1905 perfected his method of direct anastomosis of the artery of the donor with the vein of the recipient. Crile in 1907 described a method utilizing a small cannula. The disadvantages to these methods lay in the fact that the artery of the donor had to be sacrificed, the amount of blood transfused could not be determined, and the recipient's blood came in direct contact with the donor's blood. The principle of using paraffined vessels was revived by Curtis and David in 1911. Two years later this principle was utilized by Kimpton and Brown in the development of the Kimpton paraffinized tube. In 1913 Linderman revived and improved on the method described by Zilmenn in 1892, using multiple syringes. This led to the development of the syringe-valve method by Unger in 1915. This two-way-valve method became very popular and numerous syringe-valve instruments were described.

The addition of anticoagulants was another method of overcoming clotting of blood. In 1892 Landois suggested the use of hirudin. Satterlee and Hooker found it too toxic. Hustin of Belgium in 1914 repeated his experiments on the use of sodium citrate and glucose in the prevention of coagulation of blood. Agate in Buenos Aires on November 14, 1914, performed the first transfusion in which citrate alone was used as an anticoagulant. The following year Lewisohn and Weil independently advanced the technic and dosage of sodium citrate as an anticoagulant. This new method made transfusion simple, practical, and safe in the hands of most physicians. Its use in the World War did much to popularize it, and it now has been widely adopted. In a recent survey by Levine and Katzin [2] of hospitals in the United States using only one method of transfusion disclosed 98 hospitals using the citrate method as compared to 38 using the unmodified method. (Syringe valve 17, Linderman (multiple syringe) 17, and paraffin-lined containers 4.)

Blood transfusions can be performed with only slight risk to the patient under carefully controlled conditions. This is attested by the reports of Beck,[3] who reports 950 transfusions without any accidents; Schiff [4] reports 6,000 transfusions performed in Berlin and London which were complicated by 4 accidents and 1 death; and by Tiber [5] in New York who reported 1,400 transfusions with 2 deaths.

[2] Levine, P., and Katzin, E. M., Survey of blood transfusion in America, J. A. M. A. 110: 1243–1248, April 16, 1938.

[3] Beck, A., Munchen. Med. Wchnschr. 74: 398–402, March 11, 1927.
Beck, A., Ergebn. d. inn. Med. u. Kinderh. 30: 150–220, 1926.

[4] Schiff, F., Allergie n Infectionkr 2: 158–29–30.

[5] Tiber, A. M., American Surgery 91: 481–488, April 1930.

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HEPARIN

Heparinization of the donor prior to transfusion is at present receiving careful experimental study. Knoll and Schurch [6] have found that by adding heparin to the blood after withdrawal or by injecting it into the donor before transfusion a sufficient delay in coagulation can be achieved to enable a successful transfusion to be carried out. The problem of controlling the delay of coagulation in the donor requires further investigation. This method, when sufficiently developed, will make it possible to carry out a transfusion without special operative procedures, apparatus, or trained staff, since all that is necessary is a venous puncture.

CADAVER BLOOD

With death there is not a simultaneous death of all the tissues and organs. Professor Shamov,[7] in an attempt to transfer tissue from the dead animal to the living, selected blood. His experiments on animals in 1927 proved that blood from dead animals could be transferred into another animal without any signs of great toxicity, even in large quantities; that the red blood cells of dead animals 10 hours after death still retain their full vitality and are able to function physiologically as well as the red cells of normal blood; and that phagocytosis of the leucocytes is preserved for the first 11 hours after death, after which it disappears.

The first to introduce the use of cadaver blood for transfusion in man was S. S. Yudin [8] who was in charge of the entire surgical and accident service at the Skilfosovsky Institute in Moscow where from 8,000 to 10,000 emergency cases passed through his service each year. Many of the cases were brought in late at night in need of a transfusion when no suitable donor was immediately available. Numerous cases died en route or shortly after arriving at the hospital. He believed that these cases could furnish a large supply of cadaver blood for transfusion. He overcame numerous obstacles and performed his first cadaver blood transfusion on a young engineer who had attempted suicide by slashing both wrists. The blood for transfusion was taken from an elderly man who had died of an injury some 6 hours before. This first transfusion was successful and cadaver blood was used on his service for transfusion. At the Fourth Congress of Ukrainian Surgeons at Karkov in 1930 he reported his first seven cases, all of which were successful.

[6] Knoll, H., and Schurch, O., Blood transfusion with heparin, Lancet 1: 1387–1389, June 18, 1938.
[7] Shamov, V. N., Transfusion of stored cadaver blood, Lancet 2: 306–309, Aug. 7, 1937.
[8] Yudin, S. S., Transfusion of Stored Cadaver Blood, Lancet 2:361–366, August 14, 1937.
Yudin, S. S., Transfusion of Cadaver Blood, J. A. M. A. 106:997–999, March 21, 1936.

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Skundina and Rusakov [9] found that blood taken from healthy persons, who died suddenly as by drowning, heart attacks, apoplexy, or a traffic accident coagulates but that within 1 to 1½ hours this coagulum becomes liquid again and remains so, not requiring any anticoagulant. When death was due to a grave disease as cancer, tuberculosis, sepsis, or from trauma with prolonged shock the blood slowly coagulates and remains so until putrefaction sets in. These investigators found that blood which did not undergo fibrinolysis was unsuitable for transfusion.

Blood from the cadaver is withdrawn from the jugular vein 2 to 4 hours after death and never later than 8 hours. From each cadaver from 1,500 to 4,000 cc. of blood is obtained. The blood is grouped, labelled and kept at 2–4° C. It is stored and found safest for use within 10 days, however it has been used after 28 days. Besides serologic and sterility tests a careful necropsy is performed. Yudin believes the therapeutic effects of cadaver blood transfusions are the same on the whole as in using the blood of living donors; that cadaver blood if used without citrate gives a considerably lower percentage of reactions and that the reactions are less severe. Prior to the time of using only blood which had undergone fibrinolysis the reactions amounted to 20 percent. In 800 cases when only blood which had undergone fibrinolysis was used 5 percent of moderate reactions occurred. In the first 1,000 cases 7 fatalities were reported—all of these attributed to error in technique.

The adoption of this method for obtaining blood for transfusion would be beset with medico-legal difficulties and public opinion would be opposed to it. Even were this not the case it is doubtful if enough blood could be obtained by this means under normal conditions to make it practicable. It is generally agreed that the time is not ripe to recommend the use of cadaver blood for transfusion.

BLOOD BANK

Blood preservation has been popularized in this country by the introduction of the so-called blood bank at the Cook County Hospital.[10] The blood is obtained from healthy volunteer donors, from suitable patients suffering from cardiac decompensation and hypertension, from expectant mothers, from elective surgical cases prior to operation, and from convalescents from infectious diseases. Rules are set forth so that as much blood enters the bank as is dis-

[9] Skundina, M., and others, Transfusion of Cadaver Blood without Preservatives. Sovet Khir, 7:194 (Nos. 2 and 3) 1934.

[10] Fantus, B., Therapy of Cook County Hospital; blood preservation, J. A. M. A. 109: 128-131, July 10, 1937.

Fantus, B., Therapy of Cook County Hospital; blood preservation technic, J. A. M. A. 111: 317-321, July 23, 1938.

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pensed. Careful records are kept and each service is responsible for its blood account.

The varieties of blood supplied by the bank are: (1) Whole blood; (2) erythrocyte suspension; (3) nonspecific human serum; (4) convalescents' serum; (5) antepartum blood for administration to premature infants.

The blood is withdrawn from the donor, who has not recently partaken of food or alcoholic stimulant, into a 1,000-cc. sealed flask which contains 70 cc. of a 2.5 percent sodium citrate solution in normal saline. When 500 cc. of blood have been obtained the blood, together with two pilot tubes containing some of the donors' blood, is immediately taken to the blood-preservation laboratory. The blood in one pilot tube is used for the Kahn test; the blood in the other pilot tube is used for typing and cross matching. A tag is attached to the donors' flask giving information as to name, sex, age, race, together with a brief medical history of the donor.

The blood is placed in a refrigerator and kept at a temperature of about 6° C. The blood is typed by a simple method, cultures are made, and a routine Kahn is done; if it is positive a Wassermann is done. Blood which gives a positive Kahn or Wassermann is discarded and the service which furnished the blood receives no credit for it.

When a service desires to draw on its account in the blood bank it furnishes the laboratory with 5 cc. of blood of the patient who is to be transfused, for typing. The request for blood should state the variety of blood desired. The patient's blood is typed and blood of the same type is removed from the bank. A cross match is done to insure complete compatibility. The blood, if found to be compatible, is observed for evidence of hemolysis. The culture is inspected. If no growth is found the blood is strained through bolting cloth into a specially prepared flask. An equal amount of normal saline is mixed with the blood prior to filtering. In cases of emergency blood can be prepared for transfusion within 30 minutes after the recipient's tube reaches the laboratory.

A special phleboclysis set is dispensed with the blood. It contains the necessary sterile linen, etc., necessary for giving the blood. The blood is warmed in a water bath of about 105° F. just before giving. The flow is regulated to about 40–60 drops per minute. The patient is carefully observed the entire time the blood is given for evidence of a reaction. The patient receiving a blood transfusion should be carefully observed for signs of uneasiness, pain in the lumbar regions, fullness in the head or chest, dyspnea, changes in the pulse, shock, nausea, and vomiting. These are indications that the blood transfusion should be immediately discontinued. At the Cook County Hospital they have eliminated almost all reactions due to preservation

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technique by giving scrupulous attention to the preparation of all glassware tubing and needles used for transfusion. The reactions now occurring are chiefly autogenous reactions.

The majority of reactions fall under four headings: (1) Immediate reactions; (2) delayed reactions; (3) jaundice; (4) urticaria. Reactions have steadily decreased from 13 percent for the first thousand transfusions to 3 percent for the fifth thousand. Four deaths in 6,000 transfusions were directly or indirectly attributed to the effects of a reaction.[11]

They found that due to the scarcity of type AB blood about 60 specimens of blood must be in the bank to insure an adequate supply of this type. Blood cannot be safely preserved for more than 10 to 12 days, therefore the bank must be replenished frequently to avoid deterioration. Blood preservation will not pay in a hospital if there are less than 30 transfusions given a month.

Blood transfusions have increased at the Cook County Hospital from an average of 47 a month to 418 a month. For the year ending November 30, 1938, the total number of transfusions was 5,940.[11]

The number of hospitals in the United States which have adopted blood preservation in their institutions is quite large and at the present time the total of such hospitals cannot be accurately determined. Recently Goodall and his associates[12] have proposed a technic for the collection of placental blood. Placental blood banks have been established in hospitals both in this country and in England.[13]

The average yield of blood from each placenta is about 105 cc. The advantages of placental blood are absence of allergins, the supply is inexhaustible, the erythrocyte count and the hemoglobin content is high, and it contains 20 to 35 percent more coagulating power. Placental blood must be typed and cross-matched prior to transfusion for fetal blood differs in type from the maternal blood in 33 percent of the cases.

Blood preservation in naval hospitals during peace times is not practicable. Blood transfusions are not numerous in the service because the patients for the greater part are young male adults of good physique on entering the service and during their service career they are under close medical supervision. The various diseases or conditions which arise receive early treatment, obviating the need for a transfusion in large number of cases. Blood transfusions, however, are never withheld when indications for this procedure arise. The

[11] See, Linden, personal communication.

[12] Goodall, J. R., Anderson, F. O., Altimas, G. T., and MacPhail, F. L., Inexhaustible source of blood for transfusion and its preservation; preliminary report, Surg., Gynec. & Obst. 66: 176–178, Feb. 1938.

[13] Grodberg, B. O., and Carey, E. L., Study of 75 transfusions with placental blood, New England J. Med. 219: 471–474, Sept. 29, 1938.

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present system of each hospital having a portion of its staff typed so that a healthy donor is readily available is adequate.

BLOOD TRANSFUSION IN SPAIN

The Spanish Government set up a model blood transfusion organization under the control of Dr. Duran-Jarda. There was no difficulty in obtaining blood. Donors were all volunteers; they were paid nothing but were given special food concessions. Either sex was used between the ages of 15 and 50. The donors gave 300–400 cc. of blood once a month. They fasted for several hours before being bled. For mass transfusions when there was no time to type the patients' blood, universal donors alone were used. The group frequency was AB 3.1 percent, A 47.5 percent, B 7.8 percent, and O 41.6 percent. The blood was collected in a specially constructed flask aided by water suction. Ten cc. of a 4-percent solution of sodium citrate being added to each 100 cc. of blood. Bacteriological and serological tests were made, and, if satisfactory, six bloods of the same group were filtered, mixed, and bottled in units of two liters each. All this was done without exposing the blood to the air. The blood was dispensed in a tube of 300 cc. capacity, known commercially by the name of "Auto Injectible Rapid."

Air under a pressure of two atmospheres was introduced in the tube, it was sealed, fitted with a rubber tube to which is attached a filter, screw clip, two-way cock, and a beveled sterile needle in a glass tube. The tube was placed in a cardboard box and placed in an electric refrigerator where it was kept at 2° C. Blood was kept for 15 days. A supply of blood was easily dispatched to civilian hospitals or to the front line by trucks. It was kept at the desired temperature in a refrigerator en route. The administration of blood was simple and was generally given by trained orderlies. The tube of blood was heated in a water bath at 45° C. for 20 minutes before injection. The blood could be given rapidly as it was under pressure in the auto-injection tube, or it could be given by the continuous-drip method by regulating the screw clip. As many as nine transfusions have been given in less than 2 hours by one orderly. The blood was given freely and was the chief treatment for shock at the front. Several hundred tubes were always ready for immediate use.

With war clouds hanging over Europe, France [15] and England [16] are making great preparations for the use of preserved blood on a large scale both for the civilian population and the armed forces. For London and vicinity a central depot has been prepared with the necessary protected accommodations for laboratories and personnel.

[15] Foreign Letters, Paris, J. A. M. A. 111:1311, Oct. 1, 1938.
[16] Mitchener, P. H., and Crowell, E. M., The Air-Raid IV, Lancet 1:228 Jan. 28, 1939.

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Two large refrigerators, capable of storing 1,000 bottles of blood each have been designed in an underground store. Blood is obtained from civilian donors through facilities already under way by the British Red Cross Society. The British plan, in order to minimize any individual incompatibility, to adopt the Spanish method of mixing six separate half-pints of blood and to rebottle it after straining. In doing so it will not be necessary to cross-match against the recipient's own blood before transfusing.

BLOOD PRESERVATION FOR THE NAVY

It is impossible to formulate definite plans for procuring, storing, and dispensing of blood in the Navy during wartime. However, this matter is receiving careful thought so that should it become advisable a blood-transfusion service on a large scale can be speedily inaugurated. The Bureau of Medicine and Surgery has plans under way to determine the blood group of the entire service personnel. This is a great step forward. The Spanish military surgeons were greatly handicapped in giving transfusions at the front in the early days of the present war, because their soldiers had not been typed before going to the front.

Aboard ship following an engagement it may become necessary to use as donors some of the ship's personnel. Men convalescing or those suffering minor injuries could be used.

As both treated and untreated cases of syphilis are contraindicated for use as donors, a blood Kahn may be accomplished at the same time the blood grouping is done. This would add little expense, as every naval station and ship having a medical officer has the necessary equipment for performing this test. One comparatively recent negative Kahn blood test on an active service man would suffice for using him as a donor in case of an emergency.

Malaria is another disease which is transmitted by transfusion of blood even though the disease is latent.[17] [18] [19] Any service man having a definite history of malaria should not be used as a donor.

The blood group could be recorded both in the health record and on the identification tag. A new sheet could be inserted in the health record using a different colored sheet for each of the four blood groups. This sheet should also contain information as to the subject's suitability as a donor, whether he has a history of syphilis, malaria, and whether or not he is allergic. All serology reports should be recorded on this blood group sheet. On the identification tag besides stamp-

[17] Woolsey, G., Transfusion for Pernicious Anemia. Ann. Surg. 53:132, 1911.

[18] Wright, F. H., Accidental transmission of malaria through injection of whole blood, J. Pediat. 12:327-349, March 1938.

[19] Gardner, W. A., and Dexter, L., Case of quartan malaria following transfusion and treated with sulfanilamide, J. A. M. A. 111:2473-2475, Dec. 31, 1938.

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ing on the blood group a special mark could be made denoting whether or not the subject could serve as a suitable donor.

A blood transfusion service for the Navy afloat is a more complicated procedure than for troops in the field.

Each ship would in time of war become a separate unit so far as emergency treatment of the wounded is concerned. If ships were in action far removed from the home shores the transfusion problem would be complicated. It is believed that any naval engagement would be short-lived and would result in large numbers of casualties.

Wounds, hemorrhage, and shock would be the important conditions which would have to be immediately dealt with. Wounds are important in this discussion only so far as the control of hemorrhage is concerned. Pressure over the wound by a firmly applied shell dressing will check bleeding in most cases. For hemorrhage no therapy is so successful as transfusion of blood and other supportive measures as heat. Stored blood may be impracticable for use aboard ship due to the length of time it can now be safely stored. There should be available a simple and speedy means for transfusing blood on shipboard. Probably the quickest way would be to have available a number of sterile flasks containing sodium citrate solution. The blood could be dispensed in the same flask it is withdrawn by adding a few simple attachments. At this hospital we are supplied transfusion sets [20] which are received sterile ready for use. They consist of a stoppered flask which contains 70 cc. of a 2.5 percent solution of sodium citrate in normal saline. By means of a vacuum in the flask the desired amount of blood can be rapidly withdrawn from the donor. After withdrawal of the blood it can be dispensed from the same flask in which it was withdrawn. These sets would be ideal for use aboard ship.

In shock with little or no hemorrhage 6 percent gum acacia in normal saline may serve the purpose as well as blood. This has the advantage that it could be made readily available by maintaining a supply aboard ship.

An abundant supply of blood could be easily obtained for the needs of the naval service in time of war from volunteer donors, for the idea of giving blood to save life appeals to the public. Blood preservation systems could be established, copied after the Spanish method. It is possible that a large blood preservation depot on each coast, located in a large city, could furnish the amount of blood necessary for the naval hospitals and hospital ships. Blood could be dispatched to the hospital ships serving the fleet by airplane or fast moving ships. The blood en route could be kept at the desired temperature in special thermos containers or in specially constructed refrigerators.

[20] Transfuso vac sets furnished by the American Hospital Supply Corp. Chicago, Ill.

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The American Red Cross [21] following the example of the British and other European Red Cross Societies has already established about 12 blood-transfusion services in various cities of the United States. The project consists of enrolling volunteer donors who give their blood without fee for the indigent and semi-indigent patients. The Red Cross institutes these projects with the approval of local physicians, hospitals, and paid donor groups. The donors are from among salaried workers, preferably between the ages of 18 and 40 years in good health. A negative blood Kahn, a hemoglobin content of 85 percent, and a normal white and differential count are required.

These Red Cross blood-transfusion projects, along with other established blood donor groups throughout the country, could be easily expanded to great proportions in time of war and furnish the armed forces with its need of blood for transfusion.

CONCLUSION

Storage of blood has made blood readily available for transfusion. It is safe to say that the possibilities of preserved blood in medicine and surgery have not been exhausted. The Spanish Government has proven that blood is an indispensable aid in military surgery. We should formulate plans whereby preserved blood can be made easily available for hospitals and armed forces, both ashore and afloat, in the event of a national emergency.

RECORD OF APPENDECTOMY

By Lieutenant Commander H. L. Goff, Medical Corps, United States Navy

It is the purpose of this writing to establish that a medical officer treating an abdominal case should be able to determine from the health record in every instance, beyond peradventure, whether the patient's appendix is "in" or "out."

Our usual custom is to report in the medical abstract "appendicitis" only, for which the patient was hospitalized. Further, in the body of the health record, details of treatment and operation convey the full story to physicians subsequently treating the patient during the current enlistment. At the expiration of the current enlistment, however, the body of the health record is detached and mailed to the bureau. During subsequent enlistments this procedure leaves for future reference, in the health record only the meager data "appendicitis" with no mention made there whether operation was performed, and if performed, whether appendectomy was accomplished.

Cases having "appendicitis" recorded in medical abstract who present abdominal symptoms during subsequent enlistments are most likely to be misleading as follows:

[21] DeKleine, W., Red Cross blood-transfusion projects, J. A. M. A. 111: 2101-2103, Dec. 3, 1938.

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(1) Those who have been treated for appendicitis, so recorded in the abstract, not operated for appendicitis, but with right abdominal scars present as a result of injury or as a result of operation for other conditions.

(2) Cases operated for appendicitis and recorded "appendicitis," in the medical abstract, without appendectomy.

If the examination of a patient presenting abdominal symptoms reveals no pertinent scar, then the appendix must be "in." If, however, scars are present in the right abdomen, whether for appendectomy or not, together with "appendicitis" record in medical abstract, it can not be concluded that the appendix is unquestionably "out."

The examiner at this point questions the patient concerning the origin of the abdominal scars. If the patient is insane or unconscious no further information is obtainable. Information obtained from sane and conscious patients is not always to be relied upon because patients, on whom an operation was performed with the intent to remove the appendix, assume that appendectomy was performed, unless they are definitely and emphatically informed that the appendix was not removed.

It appears consequently that the surgeon might attend a case in which he would not definitely know whether the appendix was "in" or "out." In fact at a small clinical conference all the medical officers who have practiced surgery admitted that such a circumstance had arisen in each of their careers. All of these medical officers were led to erroneously believe the appendix was "out" with severe or fatal consequences to the patient.

Summary of the factors responsible for this enigmatic state:

(1) The principal cause lies in the fact that the medical abstract entry "appendicitis" gives no information whether the patient was operated on for appendicitis and more especially, if he was operated, whether appendectomy was accomplished, or not.

(2) A common error among surgeons is to record "appendectomy" which is the operation intended even when not performed. Under this heading "appendectomy," I have read several health records which stated that the appendix was not removed because of abscess or other reasons. The term "appendectomy" should be used only where that operation is completed, and "drainage of" used where that term is applicable.

(3) A less common error among surgeons is failure to inform the patient when, at operation, appendix was not removed. This failure is attributed to two main causes:

(*a*) The serious condition of the patient which preempts removal of the appendix contraindicates informing him immediately that appendix was not removed. Time passes, and the surgeon forgets to inform him, and the patient is discharged believing his appendix is out.

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(*b*) The chagrin of the operator, who, failing to find the appendix or to remove it because of lack of experience, may cause the operator to delay informing the patient. When chagrin has subsided, he may forget and the patient is discharged believing his appendix is out.

This mistaken belief on the part of the patient, may be passed on to the surgeon subsequently in attendance and be the source of an erroneous diagnosis of consequence. Further this mistaken belief that the appendix is out gives the patient a false sense of security in that he may fail to as promptly report to a medical officer for treatment as he would if he were aware that his appendix might be the cause of his ailment. I say this because it is general knowledge that men of the Navy have a marked regard for the dangers of appendicitis, and report abdominal pains early if the appendix is possibly the offender. Whereas, if the appendix is believed to have been removed they are prone to have less concern. In short, naval personnel are appendicitis conscious.

To obviate this erroneous situation it is suggested that:

(1) All patients operated on for appendicitis without successful appendectomy be promptly, repeatedly, and emphatically, informed that the appendix is "in."

(2) The term appendectomy be used only where the appendix is taken out.

(3) "Appendix not out" be written in bold type or red ink in medical abstract in all cases admitted for appendicitis where appendix is not removed, especially if operated without appendectomy.

A change in the nomenclature is recommended, for example:

APPENDICITIS, without removal of appendix, 304.

APPENDICITIS, AO, with removal of appendix, 304 AO.

(AO, Abbreviation for "appendix out," can be added to the original "appendicitis", without change of diagnosis, when appendectomy is accomplished.

When the diagnosis "appendicitis, AO" is copied on the medical abstract, the "AO" shows at a glance that the appendix is out. An interpretation of possible medical abstract terms covering all cases is as follows:

(1) APPENDICITIS—treated without operation.

(2) APPENDICITIS "Appendix not removed"—operated without appendectomy.

(3) APPENDICITIS, AO—operated with successful appendectomy.

CASE REPORT

J. L. R.; age, 28; sea 1c.

MEDICAL ABSTRACT:—

A, Appendicitis acute, 31 days, 1929.
C. & R. A., Subphrenic abscess, 97 days, 1929.
A, Right inguinal hernia, 30 days, 1931.
A, G. C. Urethritis, 4 days, 1931.
A, Syphilis, 12 days, 1935.
Admitted October 1, 1937—NAS.

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History.—Patient reported to dispensary stating that he was suffering from generalized abdominal pain and vomiting which had begun 3 days prior, after eating a meat spread sandwich. The examining medical officer noted in the record "generalized tenderness over abdomen," WBC 11,950, temperature 100° F. "*Appendectomy 1929.*"

Patient was given an SS enema without return or relief, and 12 hours later was transferred to the naval hospital with a diagnosis of "Gastritis acute."

On arrival at the hospital the patient greeted the O. O. D. with: "Well, doc, you can't get my appendix" as he bared an appendix operation scar and stated that in 1929 his appendix had been removed and the abdomen drained. Examination revealed patient critically ill, with generalized cramping pain and tenderness over entire abdomen, nausea, vomiting, and with no bowel movements since onset and no recent passage of gas. Abdominal musculature was rigid. WBC 28,500 with marked shift to left. Temperature 101.6°. X-ray conclusions: "The appearance is that of an extensive exudate in the abdominal cavity with obstruction, partial or complete, of several loops of upper ileum."

Treatment given was: Nothing by mouth. Five percent glucose in normal saline was administered intravenously. Enema gave no results and no gas was expelled. The patient continued to grow worse and it was believed that operation should be risked with the hope of relieving the intestinal obstruction.

The abdomen was opened with a right rectus incision to find the abdominal cavity filled with free pus, and all abdominal structures involved in a fulminating acute, generalized, plastic peritonitis. Extensive exploration was not attempted. A Witzel tube was introduced into a loop of markedly distended gut which presented itself. Three drains were placed in abdonimal cavity and the abdomen was closed. The patient continued to grow worse and died the next day. Autopsy revealed a gangrenous appendix perforated at the tip, which was the source of a generalized peritonitis.

The patient would not have waited 3 days before reporting to a medical officer had he realized that his appendix was still in. The medical officer first seeing the case would not have made a diagnosis of gastritis acute, nor would he have made the entry, "*appendectomy 1929*," had he not been misled by the medical abstract "appendicitis," in conjunction with the history from the patient and the presence of the operation scar. Further, this medical officer would not have waited 12 hours before transferring the patient to the hospital, had he been aware that the appendix was still in.

The surgeon saw this case when peritonitis was generalized and the patient moribund. Had the patient not been moribund, the surgeon would probably have been handicapped by a mistaken diagnosis, resulting possibly in a fatal conclusion.

CONCLUSIONS

(1) The present custom of entering only "appendicitis" in the medical abstract is inadequate and should be supplemented (pending official instructions) by "appendix not out," where such is the case, in order that, during subsequent enlistments, the medical officer will have a written record from which to draw his information.

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(2) The nomenclature should be amended to obviate possible error:

APPENDICITIS without removal of appendix 304.
APPENDICITIS AO with removal of appendix 304 AO.

(3) The patient should be emphatically informed when operated for appendicitis without successful removal.

(4) The term appendectomy should be used only where appendix is removed.

(5) A case of acute appendicitis following operation for appendicitis is presented. The case exemplifies the need for emphatically instructing the patient when the appendix is not removed, and further exemplifies how a medical officer, relying on medical abstract "appendicitis" and the misinformed history of appendectomy may make an erroneous conclusion that the appendix is out, both factors jeopardizing the patient's life.

PULMONARY TUBERCULOSIS

THE ROLE OF PNEUMOPERITONEUM IN THE COLLAPSE THERAPY

A PRELIMINARY REPORT

By Commander E. G. Brian, Medical Corps, United States Navy, and Lieutenant E. Ricen, Medical Corps, United States Navy.

The use of pneumoperitoneum to induce collapse of the lungs in pulmonary tuberculosis is a comparatively new procedure. That the peritoneum will well tolerate air in the abdominal cavity, has long been an accepted fact. For over 20 years it has been successfully used in the treatment of tuberculosis of the intestinal tract and in the treatment of tuberculous peritonitis. It has likewise been used with safety in the abdominal cavity in connection with diagnostic tests to determine the patency of the fallopian tubes. More recently Banyai,[1] Vajda,[2] Rehberg,[3] and Trimble [4] have successfully used pneumoperitoneum in the treatment of pulmonary tuberculosis. Their results were further substantiated by the work of Stokes,[5] Ferrari,[6] Centoscudi,[7] Hobby,[8] and others. The basis for the use of pneumoperitoneum is the assumption that the pulmonary compression resulting from the elevation of the diaphragm and the elimination of the respiratory diaphragmatic excursions would exert a favorable influence upon the proliferative process in the lungs.

Various investigators by different methods of approach have come to recognize the favorable influence of the elevated diaphragm in inducing pulmonary compression.

[1] Banyai, A. L., Am. J. M. Sc., 182: 352-367, Sept. 1931.
[2] Vajda, L., Ztschr. F. Tuberk., 67: 371-375, 1933.
[3] Rehberg, T., Ztschr. f. Tuberk., 75: 230-237, 1936.
[4] Trimble, H. G., Dis. of Chest, 4: 18-21, June 1938.
[5] Stokes, J. B., Illinois M. J., 73: 137-147, Feb. 1938.
[6] Ferrari, G., Minerva Med., 1: 445-449, May 12, 1936.
[7] Centoscudi, C., Riv. di pat. e. clin. d. tuberc., 10: 22-38, Jan. 31, 1936.
[8] Hobby, A. Worth, J. M. A. Georgia, 28: 159, April 1939.

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Trimble in studying the tuberculous pregnant woman noted the mechanical similarity of the upward elevation of the diaphragm occurring in pregnancy and the diaphragmatic elevation resulting from pneumoperitoneum. He found that in the latter months of pregnancy, although the elevation of the diaphragm may be only 2 or 3 cm., it is sufficient to favorably alter the course of pulmonary disease. By means of pneumoperitoneum he found two to three times this amount of elevation can be obtained.

Centoscudi and other investigators observed the simultaneous improvement of pulmonary lesions in patients who were receiving pneumoperitoneum for intestinal and peritoneal tuberculosis. Still others noted the improvement of pulmonary lesions following the accidental administration of pneumoperitoneum during the induction of pneumothorax.

It is the purpose of this paper to present a preliminary report of a series of selected cases which are receiving pneumoperitoneum in combination with other forms of pulmonary collapse therapy.

INDICATIONS

The indications for pneumoperitoneum may be roughly grouped under the following headings:

1. PULMONARY HEMORRHAGE.—It is of especial value when the presence of adhesions prevents the collapse of the lung with artificial pneumothorax or when the source of the hemorrhage cannot be definitely determined.

2. AS AN ADJUNCT TO PHRENIC PARALYSIS.—It is indicated when additional ascent of the diaphragm is needed to obtain greater compression and immobilization of the desired pulmonary area. In many instances a surgical phrenic crush or phrenic exeresis does not result in the desired elevation of the diaphragm. Here pneumoperitoneum may increase the elevation of the diaphragm to such an extent that the volume of the lung is reduced to one third its original volume. By means of the combined use of phrenic paralysis and pneumoperitoneum it is sometimes possible to close even apical cavities. Basilar cavities or lesions in which the lower lobes of the lung cannot be collapsed by phrenic paralysis will respond to the addition of pneumoperitoneum.

3. EXTENSIVE BILATERAL DISEASE.—When the patient's poor general condition, low vital capacity, and toxemia precludes the use of any other type of collapse therapy, pneumoperitoneum is the only type of collapse that can be safely used. Through pneumoperitoneum it may be possible to prepare a patient for other forms of collapse therapy at a later date when his general condition has improved to such an extent as to make him a safer operative risk. Again it may be

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of distinct value in the utterly hopeless case by alleviating the toxemia and making the patient more comfortable in addition to the marked beneficial psychological effect on those patients for whom previously nothing whatsoever had been done.

4. To supplement other forms of collapse therapy.—(*a*) To supplement unilateral pneumothorax when bilateral pneumothorax is impossible. This is usually done in conjunction with a phrenic paralysis.

(*b*) In combination with bilateral phrenic paralysis.

(*c*) In combination with bilateral pneumothorax.

5. Pulmonary Tuberculosis Complicated by Basal Bronchiectasis.

TECHNIC

The site of injection selected is usually the left lower quadrant about midway between the umbilicus and the left anterior superior spine of the ilium. The abdominal wall and the peritoneum are first infiltrated with 1 percent procaine. A 20-gage 3-inch needle is used for the injection. Air is administered with the same apparatus used for pneumothorax with additional use of a hand pump to accelerate the introduction of air into the peritoneal cavity. In our series it was found to be almost impossible to administer air without the adjunct of a pump. About 800 cc. of air is used for the initial inflation. The amount given at each refill varies between 800 and 1,200 cc. at weekly or biweekly intervals. The amount of air given and the time interval between refills varies with the individual case. Check on maximum and optimum volumes of air can be made by means of fluoroscopic and x-ray studies. The closing manometric pressure usually varies between plus 5 and plus 8.

EFFECTS, COMPLICATIONS, RESULTS

The most common after symptoms are pain in the shoulders and under the costal margins. The patient may also feel the shifting air in the abdominal cavity as he changes his position. The pain usually disappears in a few hours and is hardly ever severe enough to require removal of any air. Occasionally a slight degree of dyspnea is noted when a large amount of air is used. This can be easily controlled by reducing the volume of the next refill. If pressure symptoms become too severe they can be controlled by elevating the foot of the bed or air can be removed from the peritoneal cavity. The removal of air can be accomplished by marking the level of the diaphragmatic leaf above and the liver below, under the fluoroscope. The needle may then be inserted in this space and the air removed. Once pneumoperitoneum has been established the patient may receive refills as an ambulatory case.

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Complications are fortunately rare. Some of the more important ones are as follows: Air embolos, although a rare occurrence, must be borne in mind. However with the exercise of ordinary care in inserting the needle into the peritoneal cavity, it can be almost completely avoided. Subcutaneous emphysema although more common is not very serious as the air is usually absorbed fairly rapidly. Massive atelectasis of the lung may occur but this again is one of the rarer complications. Other less serious sequela are obliteration of the peritoneal space and free fluid in the peritoneal cavity. The accumulation of small amounts of fluid in the peritoneal cavity does not contra-indicate the continuance of pneumoperitoneum. In one instance pneumoperitoneum was discontinued because of the appearance of hernia.

The clinical results noted in our series to date are marked diminution of cough, increased appetite and generally improved feeling of well being. In addition there is a marked beneficial tonic or psychic effect even in the most advanced cases.

Case Reports

Case I.—W. A. G., Cpl., U. S. M. C., admitted June 6, 1939. Chief complaints on admission were: Productive cough, loss of 15 lbs. weight, and weakness.

Physical examination of chest revealed the following: Expansion is limited but appears to be equal. Tactile fremitus is increased over both upper lobes. Impaired percussion resonance is noted over both upper lobes. Subcrepitant rales are elicited on inspiration following expiratory cough. Bronchophony is elicited on whispered voice over this same area. Amphoric breathing both apices. Sputum consistently positive. Vital capacity 2.1, normal vital capacity 4.3. Sedimentation index 25 mm.

X-ray of chest.—There is a caseous pneumonic exudate infiltrating right apex and first, second, and third interspaces which has undergone some fibrosis. A cavity about 2.0 cm. in diameter is noted in first anterior interspace. Cross infection has occurred resulting in a caseous pneumonic exudate infiltrating left apex and first, second, third, and fourth left anterior interspaces. A large cavity is noted in the first and second anterior interspaces each measuring about 3.0 cm. in diameter. Little fibrosis is noted in the left upper chest.

Impression.—Pulmonary tuberculosis, bilateral with multiple cavitation.

Pneumoperitoneum was instituted June 7, 1939, and maintained with biweekly refills of 800–1,200 cc. Both diaphragms were seen on x-ray to be well elevated following the induction of pneumoperitoneum.

Case II.—W. J. M., C. C. M. (F. R.), admitted February 7, 1938, with chief complaint of pain in chest of two month's duration.

Physical examination of chest revealed: Marked limitation of respiratory motion both sides of chest. Tactile fremitus is markedly increased over both upper lobes. Impaired percussion resonance is noted over entire lung fields; more

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marked over both upper lobes. Subcrepitant rales are elicited on inspiration following expiratory cough over both upper lobes. Bronchophony is elicited over this same area. Vital capacity 2.4, normal vital capacity 4.1. Sputum persistently positive. Sedimentation index 20 mm.

June 8, 1939, a right phrenic crush was done with an excellent anatomical result.

X-ray of chest.—There is an infiltration of caseous pneumonic exudate throughout the entire right upper lobe to the level of the third rib. There is considerable fibrosis from the first to third ribs. There is downward extension to the entire left upper lobe from the apex to the level of the fourth interspace, with downward extension to the left lower lobe.

Pneumoperitoneum was instituted June 6, 1939. Weekly refills of 800 to 1,000 cc. of air resulted in additional elevation of the right hemidiaphragm and also elevation of left leaf as confirmed by x-ray.

Case III.—E. B. V., MM1c(FR), admitted April 7, 1939. Chief complaint on admission was a productive cough.

Physical examination of chest revealed the following: Expansion is equal but appears limited on both sides. Tactile fremitus is increased over both lung fields. Impaired resonance is elicited on percussion over both apices, more pronounced on the left. Impaired resonance is also elicited over the left base. Subcrepitant rales are elicited following expiratory cough over both lung fields. Sputum has been consistently positive. Vital capacity 2.4, normal vital capacity 4.8. Sedimentation index 19 mm.

X-ray of chest.—There is a caseous bronchopneumonic exudation infiltrating both lungs from apex to base. This process has undergone some fibrosis on left top. There is marked pleural thickening at left base.

Impression.—Tuberculosis, pulmonary, active, far advanced.

Pneumothorax collapse of the right lung was instituted April 20. Collapse has been continued with weekly refills of about 400 cc. of air. On May 15 a left phrenic crush was done with an excellent anatomical result.

Pneumoperitoneum was instituted on June 6 with weekly refills of from 800 to 1,000 cc. of air. Pneumoperitoneum resulted in elevation of the left leaf and additional elevation of the right leaf.

CONCLUSIONS

Pneumoperitoneum has a limited but definite place in the collapse therapy of pulmonary tuberculosis. Anatomical elevation of both diaphragmatic leaves results in nearly all cases. Used in conjunction with a phrenic paralysis the elevation is more marked. Symptomatic improvement as evidenced by dimunition of cough, increased appetite, and improved feeling of well being was noted in our cases. Emphasis is placed on the fact that pneumoperitoneum is not to be used as a substitute for other forms of collapse therapy, but as an adjunct or when for various reasons other methods fail. In our opinion pneumoperitoneum will prove to be a distinct advance in the compression therapy of pulmonary tuberculosis.

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ELECTRO-ENCEPHALOGRAPHIC STUDIES [1]

By Robert Cohn, M. D., and Solomon Katzenelbogen, M. D.

In deep-sea diving it has been noted that when the "inert" component of air, nitrogen, is replaced by an equivalent percent of helium, a beneficial sedative action occurs.[2] Together with workers of the Experimental Diving Unit at the United States navy yard, we attempted to determine if the characteristic cortical action potentials changed with the inhalation of helium-oxygen mixtures at normal atmospheric pressure.

Our apparatus consists of a single-channel push-pull condenser-coupled amplifier with an electromagnetic ink-writing recorder.[3] The apparatus was built in our own laboratory by one of us, according to the design developed by A. M. Grass. The frequency response of the recording unit is linear within 1 mm. between 2.5 and 26.5 cycles per second. The over-all discharge time for a D. C. pulse is approximately 0.3 of a second. The time axis of the tape is maintained at around 3 cm. per second by means of a synchronous motor.

In all the recording a "bipolar" electrode technique was employed. The grid electrode was placed in the midoccipital, and the ground electrode in the midfrontal region of the head. Small lead plates 2 by 3 mm. served as electrodes. The electrodes, each surrounded by gauze soaked in NaCl, were held in place by an elastic band. All records were taken over a 30-minute interval with the subject in a comfortable sitting position, and with the eyelids closed. Sixty-three records were made on 17 individuals. Of these records 31 were found suitable for this communication.

The suitability of the record was determined by our ability to clearly recognize and measure the dominant basic rhythm. Certain individuals on repeated tests at no time gave a brain-wave pattern which with our present-day methods could reasonably be interpreted.

Most of the oxygen-helium experiments were carried out at the navy yard. The ordinary air experiments were done at St. Elizabeths Hospital. The environment change, we believe, was not a significant factor in these experiments.

[1] From St. Elizabeths Hospital, Washington, D. C. Received for publication April 22, 1939. The authors express their appreciation of the cooperation and assistance extended them by the naval personnel of the Experimental Diving Unit at the Navy Yard, Washington, D. C.

[2] Behnke, A. R., and Yarbrough, O. D., Physiologic studies of helium, U. S. Nav. M. Bull. 36: 542-553, Oct. 1938.

[3] Garceau, E. L., and Davis, H., Ink-writing electro-encephalograph, Arch. Neurol. & Psychiat. 34: 1292-1294, Dec. 1935.

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The characteristic frequency of the voltage variation from the cortex, under conditions of relaxation and with the eyelids closed ranges between 8.5 to 11.5 peaks per second. These are the so-called *alpha* or Berger waves. Two other ranges of frequencies are usually classified: (1) the *beta* waves—between 25–50 peaks per second—and (2) the *delta* waves—between 2 and 7 peaks per second. The voltage of the *alpha* wave ranges between 10 to 100 millionths of a volt. The *beta*-wave voltage is usually much lower. The *delta*-wave voltage is often greater than 100 microvolts. *Delta* waves are most commonly

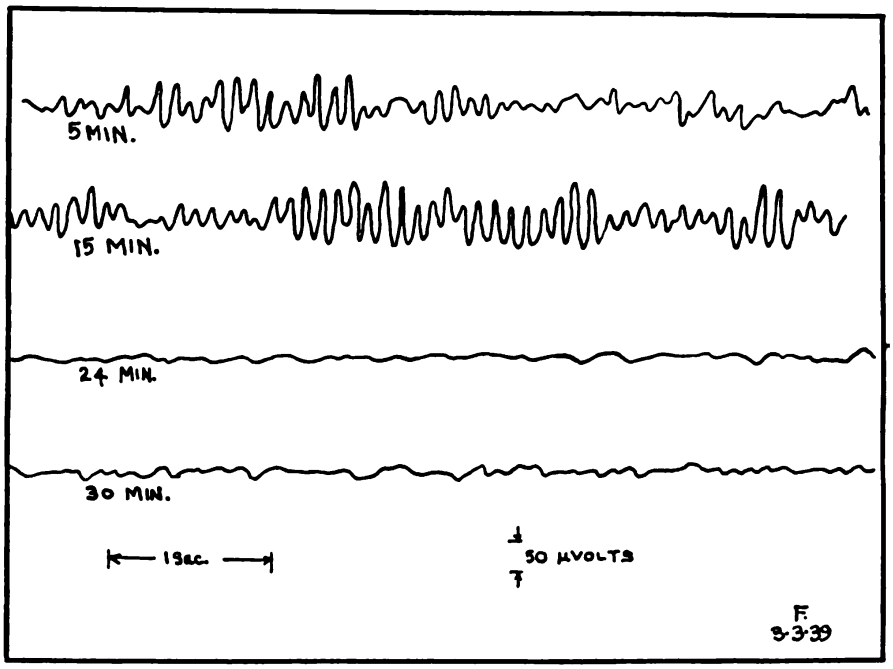


FIGURE 4.—Normal electro-encephalogram while breathing air at atmospheric pressure.

seen in certain stages of sleep and in conditions of impaired cerebral function.

A "normal" electro-encephalogram when breathing ordinary air, is seen in figure 4. The first two lines show a steady, somewhat modulated, *alpha*-wave pattern. After approximately 20 minutes of recording one notes a change in the pattern. As seen in line three, intervals of no recognizable *alpha* waves are present. These "no" *alpha* intervals are normally followed by a high-voltage low-frequency *delta*-wave pattern. It has been clearly pointed out by Davis et al.[4]

[4] Davis, H., Davis, P. A., Loomis, A. L., Harvey, E. N., and Hobart, G. A., Human brain potentials during onset of sleep, J. Neurophysiol. 1: 24–38, Jan. 1938.

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that after approximately 20 minutes' recording, the subject tires, and that a relatively low-frequency-wave pattern may predominate. Consequently, one must then believe that this figure represents an entirely normal and predicted brain-wave pattern.

Figure 5 shows a recording from the same individual when breathing a mixture of 80 percent helium and 20 percent oxygen. At no time in this record does one see intervals of "no" *alpha* waves.

Figure 6 represents the complete results of our findings to date. Each point on the abscissa of this figure represents an individual subject examined. The ordinate distance of each point from the abscissa represents the percent of *alpha* waves during each 30-minute recording. The percent time *alpha* wave is determined by obtaining the ratio of the measurements of the total time during which the *alpha* waves are present and the total time of recording, and multiplying by a hundred. Each point, of course, represents a 30-minute recording. In each of these records one of us (R. C.) was able to duplicate his counts of the percent time *alpha* within 1 percent, plus or minus. We, therefore, feel that each point in this diagram has an uncertainty of around 2 percent. The circles represent brain waves recorded while breathing the helium-oxygen mixture. The triangles symbolize the records obtained while breathing ordinary air.

From figure 6 one can see that when breathing helium and oxygen 8 subjects showed a definite increase in percent time of *alpha* waves as compared to that seen when breathing ordinary air. Five of these individuals show a fairly reproducible percent time *alpha*-wave pattern when breathing the helium-oxygen mixture.

Three individuals, at least once, showed a greater number of *alpha* waves when respiring ordinary air than when breathing the helium-oxygen mixture.

Of the above 3 individuals "T" characteristically gives an unusual brain wave pattern.

From the foregoing data we feel justified in concluding that breathing helium-oxygen mixtures, in certain individuals, definitely increases the percent time *alpha* pattern. This increase of percent time *alpha* wave may indicate an ability of helium to assist in the maintenance of an optimum oxygen supply [5] [6] to the cortex.

[5] Cameron, D. E., and Rubin, M. A., Medical Record, Page 293, April 6, 1938.

[6] Hoagland, H., Pacemakers of human brain waves in normals and in general paretics, Am. J. Physiol 116: 604–615, Aug. 1936.

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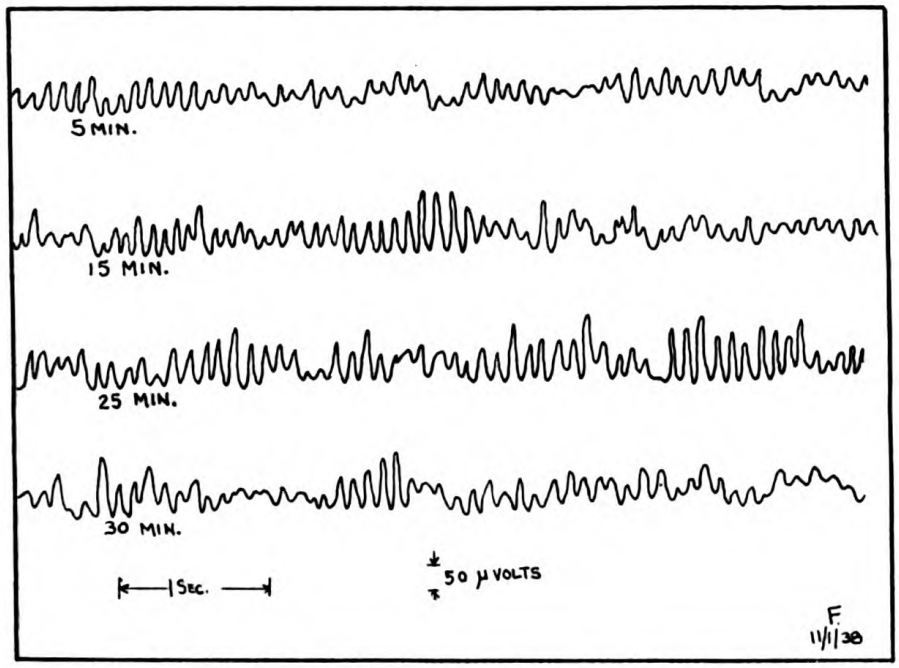


FIGURE 5.—Electro-encephalogram while breathing 80 percent helium and 20 percent oxygen mixture, at atmospheric pressure.

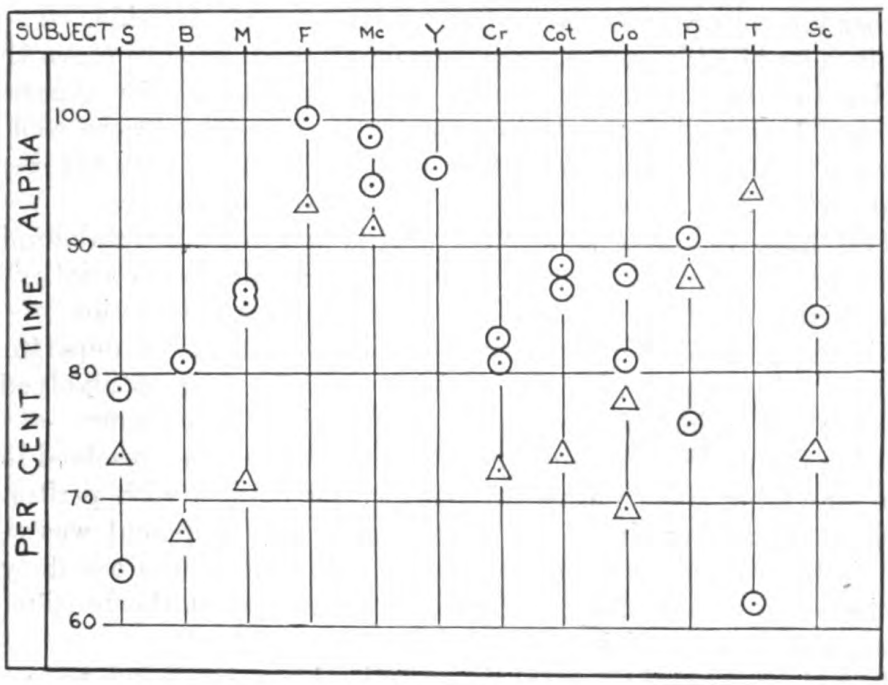


FIGURE 6.—Composite results. Each ⊙ represents a 30-minute recording while breathing helium and oxygen mixture. Each △ represents a 30-minute recording while breathing air.

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ROENTGEN TREATMENT OF ACUTE INFECTIONS[1]

WITH MODIFIED MOBILE X-RAY APPARATUS

INCLUDING CASE REPORTS

By James F. Kelly, M. D., F. A. C. R., and D. Arnold Dowell, B. S., M. D.

In 1928, under pressure of necessity, a case of gas gangrene was treated with the diagnostic mobile x-ray unit and recovered. The mobile unit was the ordinary unit designed for mobile diagnostic work in general hospitals and rated below 90 kilovolts.

In the first report[2] on the treatment of gas gangrene with the mobile unit two cases out of eight died. Both of those dying had trunk involvement. In the six who recovered the infection was entirely or to a great extent limited to the extremities. From the outcome of these cases it was thought that probably the mobile unit did not have sufficient kilovoltage to obtain the necessary depth dose to effect a cure in the trunk cases.

This led to a recommendation for the use of higher voltages in treating deep-seated or trunk infections. Since the maximum kilovoltage obtainable from the mobile unit had been used in treating the two cases which died, it was apparent that in the future cases with trunk involvement must be moved to the x-ray department if they were to be treated successfully or some apparatus producing a higher kilovoltage must be designed to treat at the bedside.

Since no bedside apparatus was available we started to move these patients to the x-ray department. This was done on a few occasions, and as these patients recovered promptly we felt we were well rewarded for our efforts. In fact we were so impressed with the results that we decided to treat other infections in the trunk.

Peritonitis following acute appendicitis and other intra-abdominal infections is relatively common and was selected for a trial. The immediate difficulty encountered was obtaining permission of the clinician to move the patient with peritonitis to the x-ray department and we fully agreed with the clinician that the dangers involved in moving the patient seemed out of proportion to the chances of improving the patient's condition. The whole thing then resolved itself into providing some means of treating the patient with peritonitis without disturbing him in any way, and as no equipment was commercially available for this purpose we felt that it was our duty to devise some means of providing x-ray treatment at the bedside for those who were too sick to be moved.

In a short tour of the local x-ray dealers' basements, we were able to select from the stock of obsolete and discarded x-ray equipment

[1] From the Department of Radiology, Creighton University School of Medicine, Omaha, Nebraska.

[2] Kelly, J. F., The X-ray as an aid in the treatment of gas gangrene, Radiology 20: 296-304, April 1933. Kelly, J. F., Present status of X-ray as aid in treatment of gas gangrene, Radiology 26: 41-44, Jan. 1936. Kelly, J. F., and Dowell, D. A., Present status of X-rays as aid in treatment of gas gangrene, J. A. M. A. 107: 1114-1118, Oct. 3, 1936.

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a suitable transformer which was mounted upon a wooden base carrying a tube stand. We found two such units and built two mobile units that have served our purpose very well. They are not, we hope, the last word in this type of equipment, as we appreciate some deficiencies in this assembly, but we look for a real piece of apparatus to be developed in the near future for this type of work as we are certain that the results will warrant its production.[3]

The first two cases of peritonitis treated were cases the surgeon was not anxious to lose. In both of these cases improvement started promptly with the beginning of the use of the x-ray and in each instance the surgeon expressed his appreciation of the value of the x-ray in treating his patient. If you wish to make some good friends among your surgical colleagues get equipped to assist them in their battle to save the lives of their patients who come in with bursted appendices and general peritonitis or who for some unknown reason develop peritonitis postoperatively, sometimes to the surgeon's surprise and embarrassment.

In presenting this brief paper it would be foolish to attempt to evaluate the exact position of the x-ray in this work. We all realize that many cases of peritonitis and infections elsewhere recover very suddenly after the battle appears lost to the patient. Why such sudden changes take place is frequently not understood by the clinician and such may have been the situation in the two cases of peritonitis mentioned above. It is possible that the x-ray had nothing to do with either recovery and that it was merely a coincidence that x-ray was started as the patient began to recover. However, the point I am trying to make is that peritonitis is a disease or a complication which may take a sudden turn for better or for worse and nothing will ever be proven in a short series of cases concerning the specific curative effect of any single measure when many remedies are being used on every case. Let it be understood, therefore, that we are not attempting to prove anything in this presentation. We are merely relating some experiences in the treatment of 24 cases of peritonitis and some other acute infectious diseases and complications at the bedside with a mobile x-ray therapy unit. We believe that it has been of definite benefit and recommend that the method be used by others, but we are not interested in attempting to prove it because of the wide variation in the clinical picture in any series of cases of peritonitis. The criticism which might be advanced against this report relative to the small number of cases treated can be answered by referring the critic to the results obtained in the treatment of inflammatory lesions in the regular x-ray department with the stationary type of apparatus for the past quarter of a century.

[3] Since this paper was presented at the AMA meeting in June, 1938 at San Francisco, some of the x-ray manufacturers in this country have built equipment especially designed for this type of work.

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There no longer can be any doubt as to the efficacy of the method, and the late Dr. Willis Manges pointed out "the effect of the x-ray in treating gas gangrene, which had resisted other direct methods of therapy, was so nearly specific that it established the x-ray indisputably as of value in the treatment of infectious processes. All other infections heretofore treated with x-ray were self-limited or responded to other measures; not so with gas gangrene."

In our opinion the results obtained in gas gangrene are not any more spectacular than those obtained in surgical mumps and many of the mixed infections met with in everyday clinical practice. One can only judge the efficiency of any method of therapy through bedside observation on the individual case. Naturally, there will be a variation in the outcome for statistical purposes, and statistics are too vulnerable and too open to manipulation to be very impressive to the average clinician, who believes, for the most part only what he sees. Our advice to all who wish to help the patient who has a localized infectious process and is too sick to be moved to the x-ray department for treatment is that he should receive treatment with a mobile x-ray unit capable of producing a satisfactory depth dose and let the clinician be the judge.

The following table shows a list of cases which we have recently treated at the bedside. This table does not include all cases treated at the bedside during the last 10 years, but is used to show the type of case in which mobile therapy is indicated.

TABLE 1

Diagnosis	Cases			Percent
	Treated	Living	Dead	Mortality
Peritonitis	24	17	7	29.16
Streptococcic cellulitis	20	20	0	0
Surgical mumps	14	13	1	7.1
Furunculosis	3	3	0	0
Erysipelas	2	2	0	0
Mastoiditis	3	3	0	0
Ludwig's angina	4	4	0	0
Gas gangrene	12	11	1	8.33
Phlebitis	1	1	0	0
Prophylaxis	9	9	0	0
Pneumonia (lobar)	7	7	0	0
Bacteremia	1	0	1	100
	100	90	10	10

PERITONITIS

Peritonitis following acute appendicitis and other intra-abdominal infections has responded immediately on many occasions. In a few instances it was necessary to treat the chest for secondary involvement in the cases of peritonitis and the response when treating over the lungs and pleura or the subphrenic area was prompt and decisive.

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Two cases dying in the peritonitis group had complete obstructions at post mortem. The x-ray will not free adhesions. Another case in this same group had a large amount of free pus in the abdomen; the only drainage instituted was a small tube in the cul de sac. One must have adequate drainage from all pus-containing cavities. One must be alert to the requirements of each individual case. Some of the acute appendicitis cases received pre- and post-operative treatment and recovered promptly.

No harm came to patients who had preoperative treatment or post-operative treatment immediately after appendectomies. We are inclined to believe that the small doses we use have no injurious effects and do not interfere with the healing of the incision.

Case Reports

Case 1.—M. K., female, age 16, admitted to hospital July 21, 1934, with diagnosis of acute gangrenous appendix. White count, 19,400; polys, 89 percent. Patient operated immediately. The appendix was greatly distended and gangrenous on the tip; free fluid in the peritoneal cavity. The following day the diagnosis of general peritonitis was made and x-ray treatment started immediately using the following technique: Kv., 110; ma., 5; distance, 50 cm.; filter, 2 mm. al.; port, abdomen anteriorly; *r* units per treatment, 60. She received one treatment the first day, two on the following 2 days, and one on the fourth day. The response was prompt.

Several features in this case are worthy of note. X-ray treatment was started the next day after operation, the incision healed by primary intention, and the patient left the hospital on the 8th postoperative day. The Wangensteen apparatus and sulfanilamide were not used. There was a steady decrease in the pulse rate which seems characteristic of cases treated with x-ray. They seem definitely less toxic very early after x-ray treatment is started.

Case 2.—T. B., male, age 22, foreman rock quarry, admitted to hospital with diagnosis of appendicitis, February 7, 1938. Operated immediately after admission and a retrocecal appendix was found. White count on admission, 18,300; polys, 79 percent. The appendix had perforated at the tip, was acutely inflamed, and there was bloody fluid and free pus in the abdominal cavity. X-ray treatment was started 2 hours after operation at 7:30 p. m. using the following technique: Kv., 110; ma., 5; distance, 50 cm.; filter, 3 mm. al; port, lower abdomen anteriorly; *r* units per treatment, 75. He received two treatments the second day, one the third day, two the fourth day, and one the fifth day.

His clinical improvement was very prompt and at no time did he show evidences of toxicity or abdominal distress such as is commonly found postoperatively. He had practically no distention. The Wangensteen apparatus was not used at any time and he received no sulfanilamide. He left the hospital on the tenth postoperative day. It is worthy of note that the incision healed by primary intention even though this patient received treatment within 2 hours after the incision was made and for the following 4 days thereafter. This fact is reported because many object to the use of the x-ray immediately following operation fearing there may be some interference in the union of tissues at the incision. In this series some cases were treated before and in others immediately after operation with no apparent effect on the operative wound.

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Case 3.—O. S., white female, age 45, admitted to the hospital April 26, 1937, for quite extensive pelvic surgery, which resulted in the removal of a uterine fibroid, appendix, tubes, and a cystic right ovary. She was operated April 27, developed a fever immediately after operation, and steadily became worse with distention and evidence of peritonitis. On the fifth postoperative day she was extremely sick with a grave prognosis when x-ray was started, using the following technique: Kv., 100; ma., 5; distance, 40 cm.; filter, 2 mm. al; port, abdomen; *r* units per treatment, 80. Two treatments were given the first day, two the second day, one the third day, one the fourth day, after which her temperature remained normal.

This patient made a spectacular and impressive recovery. The surgeon expressed his appreciation for the aid given in a case which appeared to be steadily losing ground under the usual routine treatment of the Wangensteen apparatus, transfusions, and general supportive measures. She received no sulfanilamide. She was absolutely too sick to be moved to the x-ray department and the mobile x-ray therapy unit seemed beyond a doubt to be the greatest factor in her recovery.

PNEUMONIA

We have had opportunity to treat only a few cases of pneumonia, but we are convinced by the prompt response in our cases that Powell's [4] work on the x-ray treatment of this highly fatal disease is going to revolutionize its treatment. A mobile therapy unit with adequate kilovoltage seems essential in this work.

Case Reports

Case 4.—D. T., male, age 6, admitted to hospital January 1, 1939, with diagnosis of appendicitis and hernia. Appendix removed and hernia repaired on day of admission. Two days later, January 17, clinical diagnosis of pneumonia (type 3) was made, temperature 105, but x-ray film failed to disclose any evidence of consolidation. However, x-ray treatment was given over the chest at the clinician's request using the following technique: Kv, 110; ma, 5; distance 50 cm; filter 3 mm al; port, chest anteriorly; *r* units per treatment, 60. Patient was also treated the following day. On the day following this, January 19, a film of the chest disclosed a consolidation in the upper lobe. Patient again received X-ray treatment and also one treatment per day for the following 2 days, making five treatments on 5 successive days. An x-ray film taken January 24 showed the pulmonary consolidation in the upper right lung field to have completely disappeared. Patient discharged from the hospital on the day the last film was taken.

This case was very interesting in that the patient was diagnosed clinically before the x-ray showed any evidence of consolidation and was treated once each day for a period of 5 days. The films showed the lungs clear at the beginning and at the end, the entire period being 7 days. He received no sulfanilamide. He was in the oxygen tent.

Case 5.—J. B., female, age 8, admitted to hospital, January 30, 1938, at 4:30 P. M. complaining of severe pain in the abdomen and shortness of breath. Temperature was 104.6, pulse 110. She coughed considerably and had a rusty sputum. White count on admission 20,300, diagnosis lobar pneumonia. This diagnosis

[4] Powell, E. V., Roentgen therapy of lobar pneumonia, J. A. M. A. 110: 19-22, Jan. 1, 1938.

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was confirmed by x-ray films which showed a consolidation in the upper right lobe.

X-ray treatment was started the second day after admission using the following technique: Kv, 110; ma, 5; distance, 50 cm; filter, 3 mm al; port, entire chest anteriorly; *r* units per treatment, 60. Temperature dropped the third day after admission. She was given six x-ray treatments in all and left the hospital on the twelfth day. She received no sulfanilamide, no transfusions, no oxygen. She was on a high caloric soft diet, had turpentine stupes and colonic irrigations. Dismissed February 12, 1939.

POSTTRAUMATIC PROPHYLAXIS

Some severe injuries with contaminated wounds were treated on admission to the hospital and failed to develop any infection. Some were compound fractures which united promptly without the development of gas gangrene or even the usual osteomyelitis. The outstanding result with our experimental work with animals with gas-forming organisms was that we can definitely prevent the development of gas gangrene if the animal is treated immediately after the introduction of organisms. This and our experience clinically has since led us to believe very strongly that the x-ray may be used for the prevention of gas gangrene. We recommend the routine use of a daily dose of 75 *r* for the prevention of the onset of a gas infection, but insist that tetanus antitoxin be given to prevent tetanus. This applies to all wounds in which a gas-forming infection is likely to occur, such as compound fractures and other penetrating or severely lacerated wounds.

Case Report

Case 6.—G. K., male, age 20, admitted to hospital February 14, 1938, immediately following compound fracture of left tibia. The wound was debrided and scrubbed with tincture of green soap and sterile water. Wound was then closed loosely over a soft rubber drain. Plaster cast dressing was applied, leaving an open window over the site of the external wound. He received one x-ray treatment each day for 3 days, using the following technique: Kv., 110; ma., 5; distance, 50 cm.; port, right leg anteriorly; *r* units per treatment, 80. Patient showed no evidence of infection and the wound healed promptly. New bone formation was also formed rapidly about the ends of the fractured bones and he had a firm bony union which he used for weight bearing in 4 months' time. The x-ray films show the character of the union obtained which should encourage those who are timid in the use of x-ray over fracture site, lest nonunion occur.

We believe one of the most important uses for a mobile unit is the prevention of gas gangrene in compound fractures and similar injuries.

SURGICAL MUMPS

Case 7.—J. H., male, medical student, age 23. Admitted to hospital March 18, 1938, with acute appendicitis and operated that day. The convalescence was very stormy with abscess formation in the left abdominal wall, which was drained April 14 followed by development of a severe bilateral parotitis 2 days after second operation on the twenty-ninth hospital day.

X-ray was started, using the following technique: Kv., 110; ma., 5; distance, 50 cm.; filter, 3 mm. al.; port, both parotid glands; *r* units per treatment, three

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treatments of 45, then three treatments of 60. He received two treatments the first day, two the second day, one the third day and one the fifth day. His temperature dropped promptly. A clinician who as a rule is dubious as to the effect of x-ray as a therapeutic aid expressed satisfaction with the prompt response to this treatment. He received no sulfanilamide.

STAPHYLOCOCCUS AND STREPTOCOCCUS INFECTIONS

The streptococcic cellulitis group respond more readily and remain inactive with greater certainty than do the staphylococcic group. This latter group are more stubborn, require treatment over a longer period of time and are prone to reactivate on the least provocation. The earlier x-rays are used the more effective they will be. Suppuration may occur, then drainage is indicated. Considerable tissue adjacent to the infected area should be included in the treatment.

One patient in the staphylococcus group died 20 days after x-ray treatment was discontinued. The infection was then apparently under control, but became active a few days later and the clinicians failed to request additional x-ray treatments, electing to depend upon general measures, transfusions, and sulfanilamide. Usually it is well to continue with a daily treatment for 2 or 3 days after the temperature reaches normal, then observe the case for a short time for a possible reactivation of infection.

Ludwig's angina is another serious infection which responded but less rapidly to x-ray therapy.

Case Report

Case 8.—J. C., white male, age 45, admitted to hospital March 28, 1938, complaining of pain in the right leg, fever and chills of 10 days duration. Temperature was 104, pulse 102, respirations 22. White blood count, 14,800. Gave a history of stepping on nail which penetrated his foot 2 weeks before.

Hot packs of magnesium sulphate and x-ray treatment were ordered using the following technique: Kv., 100; ma, 5; distance, 40 cm.; filter, 3 mm. al.; port, foot and ankle area, one surgace; *r* units per treatment, 60. The first x-ray treatment was given 4 hours after admission. One treatment was given each day for the following 3 days. In all four treatments were given. His temperature began to drop immediately after the first treatment and was normal the last 2 days of his stay in the hospital. He received no tetanus antitoxin and no sulfanilamide. He returned home and had no further complications. The x-ray seemed to be of immediate aid in this case and undoubtedly cut down the period of hospitalization.

GAS GANGRENE

Case 9.— H. B., colored, female, age 27, admitted April 20, 1938, with a history of having been struck on the jaw 3 days previously. The first day following the the injury the jaw was painful and markedly swollen, but the patient was not especially ill. The second day following the injury, however, the pain increased, the jaw and the side of the neck became markedly swollen and puffy. Patient had severe headache, nausea, and vomiting, and five chills during the day, each of which lasted from 15 to 20 minutes. The third day following the injury the patient was taken to the dispensary and from there was immediately sent to the

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hospital where, upon admission, an x-ray film showed a fracture of the mandible with a large amount of gas in the soft tissues. White blood count on admission 18,000, with 61 percent polys. Wassermann negative. Incision and drainage was done April 21, and a residual area of pus was drained May 4. Patient received nine x-ray treatments, using the following technique: Kv., 110; ma., 5; distance, 40 cm.; filter, 1 mm. al.; port, left side face and neck; r units per treatment, 75.

It is worthy to note in this case that the patient received no gas bacillus serum, no sulfanilamide, only conservative surgery, and made a prompt and satisfactory recovery, using the x-ray as the principal therapeutic agent.

ACTION OF X-RAYS

Desjardins,[6] from clinical observations and an extensive review of the experimental and clinical reports on the treatment of inflammations with x-ray, makes the suggestion that white cells probably undergo lysis when radiated and in this lytic process antibodies or other defense measures are presumably freed in the infected area. The benefits almost uniformly obtained through treating an infection with x-ray would lead one to believe that Desjardins' suggestion as to the effect of the x-ray in treating inflammations is correct. To free these antibodies twice each day seems particularly helpful in the fast-moving infections.

Regardless of the mode of action, one is soon convinced by the results obtained. We encourage others to treat at the bedside and judge for themselves. Where combined treatment is necessary, as in most of these cases, the clinician is at all times the best judge as to what helps the patient. The x-ray is no miracle worker, it is no cure all. It is a great aid in treating infections in various locations, is quite universally compatible, and should be used in conjunction with all the safe measures usually employed in treating the conditions.

INDICATIONS FOR X-RAY TREATMENT

IN LOCAL INFECTIONS which:

(1) Are likely to spread to adjacent tissues.
(2) May develop complications in some distant organs.
(3) Are likely to destroy large areas of tissue.
(4) Are associated with severe toxemia.
(5) Have apparently become stationary with no evidence of repair.

AS A PROPHYLACTIC MEASURE in contaminated wounds to prevent infection from becoming established (compound fractures).

IN BACTEREMIA there is no contraindication to the treatment of a local area of infection from which a bacteremia had its beginning, but in our experience we have not been able to determine whether or not any good has been accomplished by such treatment.

[6] Desjardins, A. U., Radiotherapy (roentgen rays; radium), J. A. M. A. 105: 2064; Dec. 21, 1935; 2153, Dec. 28, 1935.

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In general, where infection is present, x-ray therapy is indicated preoperatively and postoperatively.

Finally, do not depend upon x-ray therapy to prevent tetanus; use antitoxin.

DANGERS

Wherever the x-ray is used some danger is present. This has been recognized for a great many years. X-ray treatments should be prescribed only by a radiologist. Dangers are acute radiation effects, chronic or slow radiation effects, and electrical shock. X-ray treatments should be given only by a radiologist or a trained technician under the direct supervision of a radiologist; others may have trouble.

CONTRAINDICATIONS

If the treatments are given under the direction of an experienced radiologist, there are no absolute contraindications. Repeated small doses 50 to 70 *r* morning and 50 to 70 *r* evening for 3 to 5 days during the height of the infection are recommended. The correct technical factors must be prescribed by the radiologist so that the total dosage given is under the minimum which might damage the skin. This is a clinical problem and the radiologist is responsible. Not every patient treated with x-ray will get well, but in no instance has any harm, known or suspected, come to any patient receiving treatment. Always use some filter.

X-RAY TECHNIQUE

Kilovoltage: Sufficient to thoroughly penetrate the involved area; varies from 90 to 135 Kv.

Time and milliamperage: 60–100 *r* units each treatment through each port. Dosage should vary depending on size of the port. May use less on third or fourth day of the disease. Fifty *r* units probably sufficient for late treatments. Subacute cases must be treated an indefinite time, so advise smaller doses.

Ports: Sufficient to cover all involved tissues and adjacent suspected area.

Distance: 15 inches (40 cm.).

Filter: No harm has come from unfiltered therapy but we believe it to be dangerous and it is not recommended as recoveries have occurred with rather heavy (½ mm. Cu) filtration. It is recommended that some filter be used. The absence of filtration may be a legitimate criticism of this procedure and we are opposed to its omission.

Space factor: The reason for treating twice each day, which we insist upon, is based upon the observation that the results in the treatment of infections were better when the space factor or time

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between treatments approximately coincided with the rate of growth (on culture media or by clinical estimation) of the etiologic organism.

ADDITIONAL MEASURES

We have the greatest respect for the value of the Wangensteen suction apparatus. We believe this to be an indispensable aid in the treatment of many of these cases, but feel that the use of the x-ray will definitely shorten the length of time the suction apparatus is in use and in some instances where x-ray is started early the use of the tube is not required.

The use of the oxygen tent is another therapeutic development which has undoubtedly saved many lives.

Blood transfusions have also appeared to be the deciding factor in other cases.

Small doses of sulfanilamide are still an uncertain element but large doses following which the patient becomes cyanosed have, in our opinion, been definitely inhibitory to any beneficial effect the x-ray may produce. As a general rule, in the usual case, we get at least a temporary improvement following radiation therapy, slowing of the pulse probably being the most evident but in those cases which have been saturated with sulfanilamide before any x-ray treatments are given, we have failed to note even the slightest improvement following the use of x-ray. Whether the anoxemia or other blood changes associated in the sulfanilamide cyanosed patient prevents any effect from the x-ray or not cannot be stated definitely at this time, but we prefer to treat the patient without the aid of large doses of sulfanilamide.

CONCLUSIONS

This material is merely presented to make available to others who are interested some clinical facts which we have observed while treating patients with a bedside therapy x-ray apparatus. Practically all of these lesions, with the exception of gas gangrene, may or may not recover when very little is done for them, so nothing can be proven by any series of statistics; cases observed clinically are convincing. As data accumulates relative to the use of the mobile x-ray therapy apparatus undoubtedly much improvement in technical procedures will result. At the present time we have outlined the technic we have used in a general way in treating numerous infections in patients we thought it advisable to treat without moving to the x-ray department. This is done in the interest of the patient who is too sick to be moved or is held fast in a room by the oxygen tent, the Wangensteen, or transfusion apparatus, all of which are commonly used essentials in treating the seriously sick. We believe the x-ray is an additional aid in treating some of these patients and

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can be brought to the patient in the form of a mobile unit having greater kilovoltage than the present-day diagnostic (90 Kv) mobile unit.

NOTE:[6] Since this paper was written our experiences in treating patients who are receiving sulfanilamide have only strengthened our opinion, as expressed in this paper, that the x-ray effect in inflammations is definitely inhibited by the simultaneous administration of the sulfanilamide group. We no longer give x-ray either prophylactically or therapeutically to anyone receiving any of the sulfanilamide group. Puzzling complications are practically unheard of following the use of x-ray alone but seem more common after sulfanilamide. When sulfanilamide and x-ray were used in combination some very distressing complications and even fatalities occurred in cases where it did not seem quite right. If one is using the x-ray with or shortly after the administration of sulfanilamide the action of the x-ray will be very disappointing and the efficacy of the x-ray should not be judged under such circumstances.

ROENTGEN RAY THERAPY

OF ACUTE MASTOIDITIS AND ACUTE OTITIS MEDIA

By Lieutenant Commander. C. A. Swanson, Medical Corps, United States Navy

Roentgen discovered the x-ray April 29, 1895, and on December 28, 1895, announced his discovery in the publication of an article entitled "A New Form of Radiation." The developments which first followed were photographic and "x-ray pictures" were utilized to study fractures, dislocations, calculi, and bony tumors. The known bactericidal action of light soon had investigators looking for similar properties in the x-ray. The first clinical properties noted were epilation and degenerative changes in the skin analagous to burns. Probably knowing that the ray set up an inflammatory reaction in the skin, and possibly for purely empirical reasons, Grubbe [1] in Chicago on January 29, 1896, utilized roentgen therapy in the treatment of a case of carcinoma of the breast and became the first person to use the rays therapeutically.

Dionisio [2] seems to have been the first to use roentgen rays therapeutically in ear disease. In 1906 he treated 20 patients ill with otitis media and reports that 16 were cured in 3 months.

A review of the literature on roentgen therapy of otitis media in the United States seems to give priority to Beattie,[3] of Detroit, Michigan, who used it in 1920. He recorded 14 cases of acute and chronic otitis media with 9 cures. He includes in his report 15 cases of Dempster. These all were cured or improved. It is of interest to know that he states that the type of infective micro-

[6] Authors' note received under date of September 9, 1939.

[1] Grubbe, E. H., Who was first to make use of therapeutic qualities of x-rays? Radiol. Rev. & Chicago M. Rec. 55:184-187 Aug. 1933.

[2] Dionisio, J.. Traitement de l'otite moyenne suppurie chronique par des rayons x. Arch. d'elect. mid., 14:934, 1906.

[3] Beattie, R., Treatment of subacute and chronic otitis media with use of x-ray, J. Michigan M. Soc. 20: 449, Nov. 1921.

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organism made little difference, but he did not speculate as to the rationale of treatment. Dr. Amberg [3] in discussing this paper stated that in 1916 he had a case of acute mastoiditis, but because of a profound anemia, operation was deferred and in following the infective process eight different roentgenograms were taken over an 8-week period and the patient got well. He felt that the x-rays were responsible.

Yocom [4] in 1925 reported 35 cases of chronic otitis media treated by x-ray with failure in only 2. One patient had a chronic ear discharge for 30 years and made a recovery. Admiral McIntire [5] in 1928 in a lecture to the class at the Naval Medical School stated that an x-ray picture seemed to benefit otitis media cases clinically.

Granger [6] speaking before the Radiological Society of North America in Toronto in 1929 made the following statement. "In a number of cases too large to be attributed to mere hazard or coincidence, patients with definite signs of infection and occlusion, but not of softening and destruction of the mastoids were decidedly improved by the irradiation incidental to the making of radiographs and went on to resolution and cure." This observation was confirmed by several competent otolaryngologists.

Beilin [7], radiologist to Chicago's Augustana Hospital in 1932 made the comment that x-ray therapy often cleared up a case of incipient mastoiditis.

Ross [8] in 1932 reported 31 cases of acute mastoiditis and 7 cases of chronic mastoiditis with recovery following x-ray therapy. Schillinger [9] found that x-ray therapy caused an improvement in the clinical picture in 85 percent of his 45 cases of acute mastoiditis.

Cherniak and Gorodetsky [10] in Leningrad in 1934 reported 44 cases of acute mastoiditis with 50 percent complete recovery, 25 percent considerable improvement, 20 percent unknown and a 5 percent failure.

Lucinian [11] in 1936 reported 31 cases of acute otitis media with recovery. He also had nine cases of acute mastoiditis, and two required operation. In 19 control cases of acute otitis media without

[4] Yocom, A. L., Jr., X-ray treatment of chronic otitis media. Med. Herald, Kansas City, Mo., 44: 268–269, 1925.

[5] McIntire, R. T., Rear Admiral (MC), U. S. Navy, Personal notes.

[6] Granger, A., Treatment of infections of mastoids of infants, when there is no sign of destruction present, with fractional doses of roentgen rays, New Orleans M. & S. J. 84: 111–113, Aug. 1931.

[7] Beilin, D. S., Radiographic diagnosis and management of mastoiditis, Illinois M. J. 62: 513–516, Dec. 1932.

[8] Ross, W. L., Treatment of mastoiditis with X-rays, Radiology, 18: 1124–1130, June 1932.

[9] Schillinger, R., Apparent therapeutic effect of roentgen ray upon clinical course of acute mastoiditis; preliminary report, Radiology 18: 763–776, April 1932.

[10] Cherniak, W. P., and Gorodetzky, A. A., Roentgen therapy in acute mastoiditis, J. Laryng. & Otol. 49: 675–678, Oct. 1934.

[11] Lucinian, J. H., Treatment of otitis media and mastoiditis by roentgen ray; analysis of 50 consecutive cases, Am. J. Roentgenol. 36: 946–953, Dec. 1936.

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roentgen ray treatment the membrana tympani ruptured spontaneously in 5 cases, 11 needed myringotomy and 4 required mastoidectomy.

The beneficial effect of roentgen radiation upon furuncles, carbuncles and pyogenic infections has been amply demonstrated by Carp [12] and is now a well accepted fact. The testimony is so abundant as to the value of x-ray in curbing and benefiting infections that one wonders why this agent is not used more in the infections of the middle ear and adnexa. Prontylin has come so much to the forefront in the past few years that the therapeutic benefit of roentgen rays in otitis media and mastoiditis has not received the merit due it. It may be that many otologists find it difficult to appreciate that the x-ray can be so therapeutically effective, against so many inflammatory conditions, in so many different parts of the body and so become skeptical. One might properly ask "What is the rationale of this treatment?" To understand this we must briefly review what is common to all inflammation and that peculiar to otitis media and mastoiditis. Inflammation in the midear and mastoid is the same as inflammation elsewhere, being different only in location and being modified only by the anatomic structure peculiar to it.

Histologically in inflammation there is hyperemia, stasis, change in the blood and walls of the small vessels and exudation.

In the acute catarrhal or hypovirulent otitis media, the greatest change is mechanical. The eustachian tube closes, which is followed by oxygen absorption in the middle ear and a consequent negative pressure is developed in the internal canal. The vacuum causes transudation of fluid. This is probably bacterial free. In the suppurative or hypervirulent otitis media there is congestion of the mucosa of the eustachian tube, middle ear spaces and antrum. Involvement is by contiguity. The type of secretion is related to the bacterial invader. In mastoiditis the lining membrane becomes involved and almost fills the cells. Osteitis takes place and the vessels become thrombotic. Exudation is first serous and then purulent. Resolution may take place or organization with granulation tissue or osteomyelitis with breaking down of intercellular trabeculae.

The first impression why the roentgen ray seems to be so generally effective in infectious processes would naturally be the assumption that the ray has a bactericidal action. Experiments seem to disprove such an hypothesis as untenable, although O'Brien [13] states that bacteria which *in vitro* stand enormous doses of radiation, lose their virulence *in vivo*.

[12] Carp, L., Treatment of carbuncles; comparison of 4 different methods, Ann. Surg. 86: 702-706, Nov. 1927.

[13] O'Brien, F. W., Treatment of selected cases of chronic catarrhal deafness by x-rays, Radiology 28: 1-4, Jan. 1937.

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Warthin [14] was one of the first to study the effect of x-ray on tissue. Upon lymph glands he found the small lymphocytes most vulnerable to x-ray. He found disintegration of the chromatin of lymphocytes 14 minutes after exposure. In the bone marrow the large lymphocytic and myelocytic types were destroyed by x-ray exposure and the small lymphocytes were not so vulnerable as in the spleen and lymph nodes. Red blood cells seemed to be immune to x-ray effect.

Akaiwa [15] found that after irradiating a lymph node of a rabbit with ½ S. U. D. the lymphocytes were destroyed first and from 12 hours to 5 days thereafter there was marked phagocytosis and clearing up of cellular debris. Witherbee [16] in the Rockefeller Institute for Medical Research showed that the major part of lymphoid tissue could be destroyed without appreciable damage to other tissue.

Fenton and Larsell [17] have done some experimental work on the effect of x-ray on the mucosal lining of infected sinuses. Here we have a ciliated columnar epithelium structually the same as in the mastoid and midear. They found x-ray caused an early destruction of lymphocytes in the infected membrane as early as 48 hours and for several weeks thereafter. There was an increase in the number of macrophages, a possible response to the substances produced by lymphocytic breakdown. These were laden with cellular debris and they state that it is quite possible that they engulf bacteria also. They found no damage to the cilia or epithelium. Fibrosis was the end result.

In acute inflammation there is lymphatic obstruction. In acute otitis media and mastoiditis this is also true. The commonest form of mastoiditis is the thrombophlebitic type, characterized by vascular engorgement, venous thrombosis and round cell infiltration. It is in this phase that we have the greatest leukocytic infiltration and very probably the phase of greatest roentgen sensitivity.

What happens then in these cases? Since the lymph channels are plugged with lymph, plasma cells, and round cells, and since these are most vulnerable to the x-ray there is a rapid unblockage of the lymph channels and a restitution of lymph drainage through the parotid, postauricular and retropharyngeal lymph chain. Also by an early lymphocytic disintegration there may be a sudden release of antibodies or protective substances to combat and overwhelm the infection. Phagocytosis has been synchronously stimulated as is amply corrobo-

[14] Warthin, A. S., An experimental study of the effects of x-ray upon the blood forming organs with special reference to leukemias, Internat. Clinic., 4: 243–277, 1906.

[15] Akaiwa, H. and Takeshima, M., Reaction of lymphoid tissue to roentgen radiation, Am. J. Roentgenol. 24: 42–46, July, 1930.

[16] Witherbee, W. D., and others, Induced atrophy of hypertrophied tonsils by roentgen ray, J. A. M. A. 76: 228, Jan. 22, 1921.

[17] Feton, R. A., and Larsell, O., Experimental and clinical study of histiocytes in acute and chronic inflammation of accessory sinuses, Laryngoscope 43: 233–241, April 1933.

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rated by experimental work already referred to. Protein shock induced by lymphocytic destruction could explain also local stimulation of phagocytosis.

There will also be shrinkage of the tubal tonsil and all the lymphoid tissue of the nasophranyx and this will promote better eustachian tube patency with consequent improvement in drainage.

During the past 2 years 115 cases of acute otitis media were referred to the roentgenologist at the naval hospital, Washington, D. C., for roentgen ray therapy. No attempt was made to classify these cases as to catarrhal or suppurative otitis media. There were 52 males and 63 females. Two cases which we thought had inadequate roentgen ray therapy, which we will speak of later, developed acute mastoiditis. The ages averaged from 1 year to 46 years. All recovered with healing of the membrana tympani with roentgen ray therapy alone with the exception of two, which required simple mastoidectomy. Favorably impressed by such results we decided to make a more critical clinical study to evaluate roentgen ray therapy.

It had been our practice to perform a myringotomy as a rule for:

1. Severe and continuous ear pain.
2. A bulging membrana tympani.
3. Reduction in hearing to less than 3½ feet.
4. A high or septic temperature.
5. Mastoid pain.
6. Convulsions.
7. A perforation inadequate for drainage. (Pulsatory discharge.)

In the following 25 cases, although they presented one or more of the above criteria for myringotomy, we did not perform this operation and relied solely on roentgen ray therapy. In many of the cases, spontaneous perforation had occurred, or occurred during roentgen ray therapy. Cure resulted in all. Pain disappeared completely the day following roentgen ray thereapy in these cases. The ear drums were healed at least 10 days after the last roentgen ray thereapy in all cases. After the first roentgen ray treatment there seemed to be a thinning of the discharge and an increase in amount. No unfavorable result was noted in this series. There was a marked clinical improvement in the appearance of these patients 24 hours after the first treatment. (See table 1.)

During the past 18 months we have had eight cases which we have felt justified to diagnose as acute surgical mastoiditis. Six cases had acute surgical mastoiditis when first seen, and two developed it while under treatment. We realize that each case of mastoiditis must be evaluated as an entity. One cannot state in exact hours or days how long an ear may discharge before operation is indicated. Dogmatically we may cite briefly what we feel are indications for operation in acute mastoiditis.

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TABLE 1.—*Otitis media cases treated by roentgen ray therapy in which there was clinical indication for myringotomy*

CASE NO.	NAME	SEX	AGE	EAR	PAIN	NO. TREATMENTS	W. B. C. DAY PATIENT FIRST SEEN	CONDITION MEMBRANA TYMPANI - DAY FIRST SEEN	TEMPERATURE	DURATION DISCHARGE BEFORE ROENTGEN TREATMENT	RESULT	REMARKS
1.	T.H.	M	6	R	+	2	16,800	BULGING	103.6	3 DAYS	C	EAR DRUM DID NOT RUPTURE
2.	P.K.	F	4	L	++	4	14,300	PERFORATION P. D.	102	3 WKS.	C	DISCHARGE STOPPED 4 DAYS AFTER R THERAPY
3.	H.J.	M	7	B	++	4	13,000	"	"	1 WK.	C	EAR DRUM HEALED BOTH SIDES 1 WK. AFTER TREAT.
4.	E.T.	M	3	R	+	3	15,800	"	103	4 DAYS	C	
5.	A.P.	F	6	R	++	4	10,150	"	102	1 WK.	C	
6.	D.W.	M	6	B	++	3		BULGING		2 DAYS	C	
7.	G.L.	F	12	L	+	2		"		3 "	C	
8.	N.C.	F	6	B	++	4	13,600	LT. BULGING RT. PERFORATED P. D.	102	10 "	C	LT. DRUM PERFORATED AFTER FIRST TREATMENT
9.	S.M.	M	8	R	+	2		BULGING	100	2 "	C	DRUM DID NOT PERFORATE
10.	D.R.	M	4	R	++	1		"	102	6 "	C	
11.	W.L.	F	25	R	++	4	11,400	PERFORATION P. D.	101.6	3 WKS.	C	
12.	W.E.	M	19	B	++	4	14,200	BULGING	102	1 WK.	C	
13.	M.S.	F	13	R	+	4		PERFORATION P. D.	101	3 WKS.	C	DRUM HEALED 10 DAYS AFTER LAST TREATMENT
14.	H.S.	F	8	L	+	2	9,800	BULGING	102	5 DAYS	C	DRUM DID NOT PERFORATE
15.	M.V.	F	13	R	++	4		PERFORATION P. D.		4 WKS.	C	
16.	B.N.	F	9	B	+	4		"	102	3 "	C	
17.	C.D.	F	3	L	+	2		BULGING	103	2 DAYS	C	DRUM DID NOT PERFORATE
18.	C.C.	F	6	R	++	2	12,200	"	102	3 "	C	" " " "
19.	E.S.	M	5	L	+	3	11,000	"	103	2 "	C	" " " "
20.	N.S.	F	3	B	++	3	16,000	"	104	3 "	C	" " " "
21.	S.E.	F	6	R	+	2		PERFORATION P. D.	101	3 WKS.	C	HEALED MEMBRANA TYMPANI 1 WK. AFTER LAST TREATMENT
22.	B.E.	M	4	B	+	2		BULGING	"	1 WK.	C	DRUM DID NOT PERFORATE
23.	P.H.	F	6	R	++	3	14,600		102	3 DAYS	C	" " " "
24.	N.C.	F	9	L	+	4	16,000	PERFORATION P. D.	101	5 WKS.	C	HEALED 1 WK. AFTER LAST Rx
25.	N.H.	F	14	R	+	2	9,600	RED & FLUID SEEN	99.6	5 DAYS	C	DRUM DID NOT PERFORATE

M = MALE · F = FEMALE · + = PAIN · ++ = PAIN WITH MASTOIDISM - REQUIRED NARCOTIC · C = CURED · W.B.C. = WHITE BLOOD COUNT · P.D. = PULSATORY DISC.

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1. Suppurative otitis media 3 weeks plus duration.
2. Persistent or sudden rise of temperature.
3. Profuse discharge or the sudden cessation.
4. Pain when it disturbs sleep.
5. Mastoid tenderness.
6. Intracranial complications.
7. Sinking of posterior superior wall.
8. Swelling over mastoid or in neck.
9. Marked hearing impairment.

The eight cases we had, presented all the findings enumerated except that none showed evidence of intracranial complications or mastoid perforation. In all these cases irradiation showed immediately a marked improvement or what Schillinger [18] calls "The syndrome of favorable action." Six cases received four irradiations and went on to cure. The eardrums healed and hearing was normal by whispered voice (15/15). In these six cases there was:

1. Sudden cessation of pain.
2. Lowered fever.
3. Lessened discharge.
4. Change in the character of the discharge.

Schillinger [18] theorizes why this is so and we concur in his thoughts of the probable reason for this.

1. The lowered temperature is probably due to diminution in the quantity of toxin and the number of germs that find their way into the general circulation.
2. The cessation of pain is probably due to lessened pressure in the mastoid cells and the cessation of toxins filtering into the sensitive periosteum.
3. The lessened discharge is probably due to more effective lymphatic drainage.
4. The change of secretion is probably due to lessened tension, and the mucous glands are more free to secrete. The addition of a mucoidal element to the bacteria and cells already present affords more effective ciliary action in the antrum and midear, hastening resolution.

Two cases, however, required operation, and I will briefly enumerate the history in each.

Case Reports

Case 1.—R. S., age 6, female. On April 7, 1938, this patient was first seen with spontaneous rupture of the left membrana tympani. One roentgen-ray treatment was given and the patient was not seen until April 25, when the child was again brought into the dispensary because she was not doing well. There was a nipple type perforation and sagging of the posterior superior canal wall. Temperature, rectally, 105°. Patient was sent home under outpatient care and was placed on prontylin—5 grains every 6 hours. She responded to this and the temperature returned to normal. On May 1 the septic temperature recurred, probably due to prontylin being discontinued. She did not do well, and on May 8 she was operated upon. A coalescent type mastoiditis was found, with hemolytic streptococcus the infective organism. Convalescence was prolonged and it was not until two blood transfusions were given that she rallied. Pyelitis was a complication.

[18] Schillinger, R., Roentgen therapy in acute mastoiditis, Arch. Phys. Therapy 19: 295-301, May 1938.

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Case 2.—D. W., age 8, male. This patient was first seen December 10, 1938. The right ear drum had ruptured spontaneously on December 9. On December 10 and December 12 he received roentgen-ray treatments. He improved symptomatically, so the mother did not return with the patient as requested, and as she stated, he seemed too well to warrant a trip 15 miles to the dispensary. On December 29 the patient was again seen with what looked like a fulminant mastoiditis. Roentgen-ray therapy was not readily available and the patient was placed on prontylin, 5 grains every 6 hours, which did not alter the subsequent course of the disease. A myringotomy was done. The white blood count varied from 19,200 to 22,800 on three counts on 3 successive days. Greisingers' sign was suspiciously positive. On December 31, the patient was brought to the city and a roentgenogram was taken and roentgen-ray treatment was given at this time. The roentgenogram showed an acute mastoiditis. We felt that when there seemed to be impairment to the flow of blood in the mastoid emissary vein and when the described symptoms were not affected by adequate drainage and general supportive measures, operation was indicated. Due to conditions beyond our means, this patient was not early treated in the optimum way. However, the patient had a completely healed mastoid wound and ear drum within 13 days. We felt the rapidity of healing may have been occasioned by the roentgen treatment on December 31.

The x-rays in all the eight cases showed acute mastoiditis and in none of this series of eight was there note made of trabecular break-down. We must agree with Schillingers' [18] assertion that the manifestations which make operation imperative are clinical and not radiographic. With signs of intracranial complications, a sinus thrombosis, a Gradenigo syndrome, a facial paralysis or a Bezolds' abscess we certainly would not delay surgery, but we believe roentgen-ray therapy could be used as a therapeutic adjunct. If the roentgenologist reports a coalescent mastoiditis (with break-down of cellular trebeculae) operation is necessary. If he reports a far forward lateral sinus, we would watch carefully because of the danger of sinus thrombosis. Likewise with a sclerosed type of mastoid with infected cells in the squama and tegmen, we certainly would watch for intracranial complications and intervene early in these cases if the symptoms did not readily abate.

The x-ray dosage per treatment as recommended in the x-ray service of Commander J. P. Owen (M. C.), United States Navy, is as follows:

For mastoiditis:

K. V. P.	140.
M. A.	5.
Distance	12 to 14 inches.
Time	3 minutes.
Filter	¼ mm. Cu and 1 mm. Al, measured in air.
Roentgen units	75.

The treatment can be given daily for four successive days if the clinical symptoms warrant it. In many cases there is no need for more than one or two treatments.

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FOR ACUTE OTITIS MEDIA:

K. V. P.	122.
M. A.	5.
Distance	12 to 14 inches.
Time	3 minutes.
Filter	3 mm. Al, measured in air.
Roentgen units	75.

The above treatment can be given for four successive treatments. Clinical improvement occurs usually after one or two treatments and four treatments are seldom needed.

Clinically we have not seen any serious effect following roentgen ray therapy. In one case there was epilation. Desjardins[19] states that roentgen therapy has never had an unfavorable effect in his experience. Thielmann[20] without giving details, states that roentgen irradiation of the petrous bone of white mice caused hemorrhage in the basal windings of the cochlea and the region of the crista acustica. In the middle ear there was serous exudation. No injury, however, to the auditory apparatus of human beings has ever been reported. Girden[21] reports that cumulated doses up to 11,000 roentgen units failed to produce obvious auditory impairment in dogs. There is no contraindication to roentgen therapy in acute mastoiditis and acute otitis media. Our experience with this agent in chronic otitis media is too limited for inclusion in this report although in a few cases it has seemed to be of benefit.

SUMMARY

One hundred and thirty-nine cases of otitis media were given roentgen ray therapy over the ear and mastoid. The treatment resulted in rapid amelioration of symptoms. Twenty-five cases were treated with roentgen ray therapy when we felt myringotomy was indicated, although the ears in certain cases had ruptured spontaneously. In these cases there was pulsatory discharge. This was the sole therapy. All resulted in prompt cure. Two cases with what we felt had inadequate roentgen ray therapy, developed mastoiditis and were operated. Six cases had frank surgical mastoiditis and resulted in cure.

We feel therefore, that roentgen ray therapy in acute otitis media and acute mastoiditis is a valuable therapeutic adjunct when properly applied. No deleterious effects have been observed in our experience. There is sound theory for its use.

[19] Desjardins, A. U., Action of roentgen rays and radium on eye and ear; experimental data and clinical radiotherapy, Am. J. Roentgenol. 26: 639, Oct.; 787, Nov. 1931.

[20] Thielmann, Experimentelle roentgenschadigungin des ohres. Fortschs. A. d. Geb. d Roentgen Strahlen., 37: 563, 1928.

[21] Girden, E., and Culler, E., Auditory effects of roentgen rays in dogs, Am. J. Roentgenol. 32-675-679, Nov. 1934.

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SHORT-WAVE DIATHERMY [1]

By Commander John P. Owen, Medical Corps, United States Navy

High-frequency currents were first described in 1891 by Telsa, of Budapest, who noted the heating action when these currents were applied to insulated bodies. D'Arsonoval in 1892 reported the total absence of neuromuscular action when the frequency was sufficiently high. De Forest's [2] principles of electronic oscillations in 1924 were the beginning of scientific investigation of the effect of the oscillating field on living cells. Schereschewsky [3] reported experiments indicating a specific lethal action of short-wave diathermy. This specific lethal action was disputed by the work of Christie and Loomis.[4] In 1929 Schliephake[5] reported the cure of a furuncle on his nose. This is the first instance where short-wave diathermy had been used for the treatment of infection.

Since that time the use of short-wave therapy has grown by leaps and bounds. It has relegated into the background the conventional diathermy of the spark gap machines (300-meter-wave-length area, and the damped oscillations). It has caused the conglomeration of short-wave machines that now flood the market.

Dr. Schliephake [5] describes the method of treating tuberculosis, bronchiectasis, carbuncles, and many other diseases. He lists 87 diseases in the clinical index of his book. He states that cholecystitis is generally relieved in a few sittings and that syphlitic aortitis is considerably improved. Our clinical experience does not confirm the value of short-wave diathermy in some of these conditions.

Short-wave diathermy mostly in the 16- to 20-meter area has been a routine method of application of heat in our naval hospitals for several years. We have not observed, up to the present time, any mysterious healing effect that will justify the claims being made by some manufacturers regarding the specific action of certain wave lengths, particularly in the 3- to 12-meter area. It is true, due to the ease of application and more uniform heating of the tissues, that we are now using short-wave diathermy in a larger variety of cases and much more frequently than in the days of conventional diathermy.

[1] From U. S. Naval Hospital, Washington, D. C.

[2] De Forest, E. Lee-Kobak, Disraeli: Short Wave Diathermy, in Hollender, A. R.: Physical Therapeutic Methods in Otolaryngology, St., Louis, C. V. Mosby Co., 1937, pages 59–83.

[3] Schereschewsky, J. W., Physiological effects of currents of very high frequency (135,000,000 to 8,300,000 cycles per second), Pub. Health Rep. 41: 1939–1963, Sept. 10, 1926.

[4] Christie, R. V., and Loomis, A. L., Relation of frequency to physiological effects of ultra-high frequency currents, J. Exper. Med. 49: 303–321, Feb. 1929.

[5] Schliephake, Erwin: Text book, Short Wave Therapy, The Actinic Press.

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Our use of this modality is based on the findings of sincere, conscientious, and trained investigators such as:

Mortimer,[6] who found that when the living animal is subjected to short-wave oscillations the temperature of the various organs equalizes due to the rapid transfer of heat by the circulating blood.

Mortimer and Osborne, [7] who showed the cuff and coil method as being the most effective for heating tissue.

Mortimer and Beard,[8] who came to the conclusion that there was no advantage of any one wavelength over the other, in heating living tissue.

Bierman and Schwarzschild,[9] who compared the effect of conventional diathermy and short wave diathermy on living tissue and found that short wave diathermy does cause an elevation of intramuscular tissue, as high or higher than conventional diathermy.

Coulter and Carter [10] using 6, 12, 18, and 24 wavelengths, found no difference in heating living tissue when using the cuff method, and no significant difference when using 12, 18, and 24 meters with the electromagnetic field method (coil).

Coulter and Osborne [11] using wavelengths from 6 to 24 found that the wavelength in itself was not a marked factor in heating tissue. They demonstrated that the electromagnetic field method (coil), electric field (cuff), and disk method, rate in the order mentioned in elevating the temperature of living tissue.

Krusen [12] in an exhaustive review of the literature comes to the conclusion that short wave diathermy is an excellent method of application of heat and leaves the subject open for further investigation.

Finally Chaffee [13] states that the circulating blood is a powerful agency toward equalizing the body temperature, and he feels quite certain that no specific effect of any particular frequency has been proved to exist. Nor is there any reason to expect any specific effect, because the highest frequencies used are too low to elicit any specific molecular activities.

With the findings of these investigators before us, it is evident that there is no miraculous specific effect in the living body for any particular wave length, and there is no specific selective heating. And furthermore, there is no specific action on bacteria except as the degree of heat is increased.

If we have arrived at this conclusion there is nothing left for us to accept but the fact that short wave diathermy is a most effective method of applying heat to human tissue when heat is indicated.

During the past 5 years in our hospitals and on our hospital ship, we have had the opportunity to observe the results obtained by apply-

[6] Mortimer, B., Experimental hyperthermia induced by high-frequency current, Radiology 16: 705–719 May 1931.

[7] Mortimer, B., and Osborne, S. L., Tissue heating by short wave diathermy; some biologic observations, J. A. M. A. 104: 1413–1419, April 20, 1935.

[8] Mortimer, B., and Beard, G., Tissue heating by short wave diathermy, J. A. M. A. 105: 510, Aug. 17, 1935.

[9] Bierman, W., and Schwarzschild, M., Therapeutic use of short wave currents, New England J. Med. 213: 509–517, Sept. 12, 1935.

[10] Coulter, J. S., and Carter, H. A., Heating of human tissues by short wave diathermy, J. A. M. A. 106: 2063–2066, June 13, 1936.

[11] Coulter, J. S., and Osborne, S. L., Wavelength in heating of human tissues by short wave diathermy, J. A. M. A. 110: 639–641, Feb. 26, 1938.

[12] Krusen, F. H., Present status of short wave diathermy, J. A. M. A. 110: 1280–1287, April 16, 1938.

[13] Chaffee, E. L., Physics of high frequency currents as used in medicine—diathermy, radiothermy, and electric knife, New England J. Med. 213: 505–508, Sept. 12, 1935.

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ing heat of this nature to approximately 1,000 cases, and during the past year we have observed and recorded the results on 236 cases, as noted in the following tables:

TABLE 1.—*Conditions benefited by short-wave therapy*

Diagnosis	Number cases	Number treatments			Wave length		Results	
		Minimum	Maximum	Average	6 M.	18 M.	*a*	*b*
Arthritis	38	5	69	17	10	28	23	15
Prostatitis	20	8	55	19	6	14	11	9
Low back pain	40	2	48	8	12	28	33	7
Sinusitis	16	2	57	18	3	13	9	7
Myositis	16	2	36	14	5	11	13	3
Contusion	16	3	21	12	4	12	16	0
Bursitis	6	4	54	19	2	4	2	4
Fractures	6	5	25	15	1	5	4	2
Phlebitis	3	4	20	10	3	0	2	1
Carbuncle	3	4	60	35	2	1	3	0
Gout	3	8	14	10	1	2	3	------
Neuritis	2	10	35	22	0	2	1	1
Bells Palsy	2	6	12	9	2	0	1	1
Cellulitis	1	0	7	7	1	0	1	------
Bronchitis	2	3	8	5	1	1	1	1
Pleurisy	2	10	4	12	1	1	2	------
Sciatica	7	9	48	22	3	4	3	4
Torticollis	9	1	16	4	3	4	8	1
Hyper. Arth	3	3	15	6	0	3	3	------

a. Gradual subjective improvement.
b. No objective or subjective improvement.

TABLE 2.—*Conditions not benefited by short-wave therapy*

Diagnosis	Number cases	Number treatments			Wave length		Results	
		Minimum	Maximum	Average	6 M.	18 M.	*a*	*b*
Salpingitis	10	1	27	12	3	7	9	1
Mental cases	7	5	25	15	2	5	7	0
Buerger's disease	2	13	16	14	2	0	2	0
Otitis media	3	12	15	3	3	0	3	0
Abscess	2	5	28	16	2	0	2	0
Gastritis	2	12	15	13	0	2	2	0
Hemiplegia	2	5	20	12	0	2	2	0
Lung collapse	1	0	5	5	1	0	1	0
Pernicious anemia	1	0	12	12	1	0	1	0
Tumor, spine	1	0	73	73	1	0	1	0
Cancer, breast	1	0	7	7	1	0	1	0
Epilepsy	1	0	3	3	1	0	1	0
Osteomyelitis	1	0	17	17	1	0	1	0
Vertigo	1	0	28	28	1	0	1	0
Cyst, coccyg	1	0	28	28	1	0	1	0
Fibroma, P. O	1	0	16	16	1	0	1	0
Coryza	2	3	3	3	2	0	2	0
Tonsillitis	1	0	5	5	1	0	1	0
Bronchiectasis	1	0	3	3	1	0	0	1

a. No objective or subjective improvement.
b. Subjective condition worse.

Under ordinary circumstances many of the cases reported in these tables would not have received short-wave diathermy of any length, but because of the large field Dr. Schliephake [5] has suggested in the clinical index of his book and because of the claims made by certain salesmen, it was decided to treat as large a variety of cases as possible with machines of 6- and 18-meter wave length.

This work was not undertaken to prove that short-wave diathermy is or is not an efficient method of applying heat. That fact has been

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proved and accepted. These tables demonstrate what results we have had in a small series of cases over a period of 1 year, and they compare favorably with many hundreds of cases previously observed. They represent our clinical experience in the use of short-wave diathermy, and give us an opportunity to compare the results obtained with 6- and 18-meter wave lengths.

In table 1 we have 135 cases treated with 18-meter wave length and 60 treated with the 6-meter machines. There was not observed any striking difference in the reaction of the patient when using 6 or 18 meters.

It is true that the disk method is more impressive and many patients state that they feel better when the air-spaced electrodes were used. It is possible that a few flourishes of the neon bulb further impresses a certain number of patients. Neither did we observe any difference in the effect on the patients when using glass electrodes as compared with other types of electrodes. The method of application varied according to the location of the pathological condition and for convenience of the patient, and consisted of:

1. Electric field method cuff.
2. Electro-magnetic field coil.
3. Disk method, air-spaced electrodes.

The time of the treatments varied from 10 to 20 minutes and the patients were allowed to rest for a short time before leaving the clinic.

It was noted that many of our arthritic patients showed gradual improvement, subjectively. Certainly short-wave diathermy is an invaluable aid in the case of these unfortunate individuals, but this form of treatment is not a cure for arthritis. Destroyed cartilage does not regenerate and "hawk-bill" spurs do not vanish after one or any number of these treatments. This is confirmed by x-ray films before and after treatment.

Short-wave diathermy is used in the treatment of prostatitis only as an aid to the urologist in his routine procedure. When we are able to raise the temperature sufficiently to destroy the gonococci and not hurt the patient, it will be ideal.

While we are searching for the cause, short-wave diathermy is ideal symptomatic treatment for low back pain. Relief from pain by these treatments will be greatly appreciated by the patient and also eliminates the only indication we have for the administration of a sedative.

Undoubtedly short-wave diathermy is a valuable aid to the nose and throat specialist in the treatment of sinus infections. Probably many useless sinus operations could be avoided by this conservative procedure.

Patients suffering from myositis, bursitis, contusion, neuritis, torticollis, lumbago (chronic hypertrophic arthritis), and pleurisy are very

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grateful for the relief of pain. Any procedure that will relieve pain without the administration of narcotics should be used more frequently.

It will be noted that we have recorded three carbuncles in table 1 and no cases of furuncles or erysipelas. The carbuncles that we have treated with short-wave diathermy did not respond. Our routine treatment of carbuncles is x-ray plus short wave diathermy. If they do not respond to this form of therapy, excision of the lesion is indicated.

Infections of the upper lip and nose are always treated with small doses of lightly filtered x-rays. This includes furuncles. All furuncles are treated with x-rays and not short-wave diathermy. They usually respond immediately.

When the area involved is small, our treatment of erysipelas is ultraviolet (blistering dose). Serum and x-rays are used in some cases.

Table 2 shows 19 cases where short-wave diathermy did not appear to be of any particular value. One case of salpingitis complained of more pain and profuse menstruation. The bronchiectatic case had severe coughing spells following the treatment. The abscess cases were drained surgically. We did not expect any improvement in the mental cases.

SUMMARY

1. Short-wave diathermy is probably the most satisfactory method of applying heat when penetrating heat is indicated.
2. It should be used when indicated for the relief of pain.
3. It is not the treatment of choice for carbuncles, furuncles, or erysipelas.
4. It is not a cure-all for innumerable diseases and the indications for its use should be recognized by a qualified physician.
5. There has been no difference observed in the clinical results when using 6- or 18-meter wave lengths.

ASPHYXIA [1]

PREVENTION FROM THE NAVAL STANDPOINT

By Rear Admiral Ross T. McIntire, Surgeon General, United States Navy

In the consideration of asphyxia from the naval standpoint, it should be stated that naval personnel is not only confronted with many of the general hazards met by civilians in industrial occupations, but also with risks incident to special environmental conditions aboard naval vessels.

[1] Presented at a meeting of the Society for the Prevention of Asphyxial Death in the Auditorium of the Medical and Public Health Building, New York World's Fair, June 28, 1939.

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The medical problem in handling asphyxia cases at sea then differs very greatly from that in civil life. As in all other forms of the practice of medicine, the Navy Medical Corps endeavors to approach this problem from the preventive standpoint. For this reason, in our Service, we have certain specialty groups that are trained for all such emergencies. Moreover, life aboard ship is a very well organized and regulated one and these groups are brought into action very rapidly. The problem at our shore stations more nearly approaches that of the civilian one, but here again we have our well-organized fire and rescue parties, which are on call at all times.

Perhaps it is well at this time to give a simple definition of asphyxia. By the term "asphyxia" is meant fatal or deleterious result of any interference with normal processes of respiration. Thus, the processes of asphyxiation may be technically understood to include any interference with the adequate supply of oxygen to the tissues.

Fire at sea is one of the great hazards of all seafaring people, whether naval or civilian. The modern vessel is made up of a very large number of air- and water-tight compartments. In the event of fire, due to electrical material or oil, in these small compartments, the formation of CO and CO_2 is marked, and tends to result in an acute oxygen deficiency. Personnel trapped in such compartments may be exposed to a dangerous concentration of these gases, in addition to other risks. First-aid groups are especially trained in resuscitation and since the use of oxygen has become better understood, all of these parties are equipped with such apparatus as is needed to meet the emergency, whether due to fire, gas, or submersion.

If a scientist were to seek a perfect agent of destruction by asphyxiation, he might well despair of finding a more apt candidate than carbon monoxide. Only in one respect would it fall below his most rigid standards. There is a certain time element required for carbon monoxide to accomplish its deadly effect. Its insidious approach then is its great danger, and unless prompt treatment is available the damage resultant from general anoxemia is so marked that recovery is impossible.

In submarines all personnel is supplied with an apparatus which contains the necessary chemicals to neutralize carbon monoxide.

High-explosive shells which penetrate into a vessel and burst release more or less amounts of CO. The gas tends to find its way into adjacent compartments where unprotected personnel may be located and overcomes them. Firing of guns on one's own ship, in closed spaces, such as turrets, is a definite source of CO; that is, after the firing of the gun the breech is opened and some of the gas escapes into the compartment, although the major portion is forced out through the muzzle by the compressed air. In the American Navy

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we have had very little trouble from this source, but there are many cases of CO poison in foreign navies.

Where nitro explosives are incompletely detonated, or subjected to slow combustion, especially in confined spaces, nitrous gases are generated, consisting mainly of nitric oxide and nitrogen peroxide. The slower the burning the greater will be the amount of nitrous gases produced. This gas tends to cause but little irritation when first inhaled, but after a short latent period the symptoms and signs of acute pulmonary congestion and edema, with accompanying cyanosis and asphyxia, appear rapidly. The clinical picture resembles rather closely that due to phosgene poisoning, one of the war gases. The essential feature of treatment is oxygen therapy.

A number of serious instances of nitrous gas poisoning occurred in both the British and German vessels during and following the battle of Jutland. The slow rate of burning of nitrous explosives also causes a heavy concentration of CO_2, and a considerable amount of CO. The unfailing presence of CO_2 hastens the onset of the toxic symptoms that result from nitrous gases. When explosion or fire involving nitro-ammunition occurs aboard ship the area should be vacated at once and the compartments ventilated as rapidly as possible. Our Service respirators, used for rescue and salvage purposes. provide protection for a short time only.

A rather common cause of asphyxia is due to the fumes from fire extinguisher apparatus. Apart from the risk of encountering carbon monoxide and possibly nitrous gases in fighting fires in confined spaces in wartime, an additional danger has arisen from the toxic gases evolved by chemicals, such as carbon tetrachloride when it is sprayed on fire. The chief decomposition products are phosgene, chlorine, and hydrochloric acid. Attention should be called at this point to the danger of carbon tetrachloride as it is used as an ordinary cleaning fluid. Many accidents have occurred from its excessive use and from allowing it to be exposed to heated surfaces. Great care should be used to see that children have no access to this compound. The vaporous carbon tetrachloride is a dangerous narcotic in itself. Again the use of oxygen plays a prominent part in the treatment.

Phosgene, like the nitrous gases, if inhaled in a sufficient amount, will lead to asphyxia, due to pulmonary edema.

As has been previously stated, oxygen deficiency may occur as a result of fire in confined spaces in a ship, and the presence of carbon monoxide and carbon dioxide adds greatly to this danger. It is found in badly ventilated compartments, such as in holds and bunkers of commercial ships. Oxidizable, or oxygen absorbing materials, such as grain, fruit, or potatoes are among the most common offenders. Certain mysterious accidents, with fatalities, have been reported in recent years, in both the United States and British Navies,

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where men were suddenly overcome when entering a compartment. These are usually in the bottom of a ship, or in spaces that are in the false hull or blisters, which are below the waterline.

Such an incident, dramatic in its suddenness, occurred in the battleship *New York* 10 years ago. An officer and three men entered an upper blister compartment which had just been opened, after being closed for several months. The officer, who was leading, started down the ladder to the lower compartment and suddenly fell to the bottom in collapse. The three men immediately descended to his assistance and were also overcome. Five additional unprotected persons attempted to reach the victims and were prostrated—nine in all. The officer and one man were dead when finally removed by a rescue group.

Another disaster was reported by the Cavite Navy Yard in the Philippines, in 1931. Three civilian workmen entered a freshly painted submarine pontoon, without taking the necessary precautions. All three were fatally overcome and three additional persons going to their assistance were removed in a state of collapse, but recovered. All of these cases were due to a lack of oxygen in the compartment.

The present preliminary precautionary measures to be taken are:

1. Preliminary testing of the space for oxygen content, with a safety lamp.
2. Thorough ventilation of all parts prior to entering.
3. The adjustment of a lifeline to a person entering.
4. The wearing of an oxygen apparatus.
5. The use of a rustproof coating which does not absorb oxygen, to be applied to all surfaces in lieu of ordinary linseed oil paint.

A new hazard from asphyxia has appeared in the dangerous concentration of carbon monoxide from airplane engine exhausts on board airplane carriers, and at our shore air stations. Fortunately we have had no fatalities thus far. To the civilian mind this is comparable to the situation that has caused so many deaths in closed garages, where automobile engines have been left running. Carbon monoxide had accumulated and caused asphyxia without sufficient warning for the victim to do anything about it. Naturally, the concentration of carbon monoxide in the bloodstream of a pilot would not be conducive to a normal takeoff from the ship.

Prior to 1930, drowning was the leading cause of death in the Navy. It has since been replaced by automobile accidents. However, drowning is still the leading cause of accidental fatal asphyxia. To reduce the incidence of asphyxia from drowning, rescue parties are given special instruction in the proper technic of resuscitation of the men who have been submerged. This takes in thorough instruction in the clearing of the respiratory tract, artificial respiration, and the

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demonstration of the use of oxygen. More attention than ever is being given to swimming instruction among Navy personnel.

The hazards of asphyxia in submarines in the performance of normal duty is always one of grave concern. In this class of vessels the hazards, due to noxious gasses, are greater than in any other, because of the peculiar structural characteristics of the vessel. An additional risk is faced by the danger of access of sea water to the batteries used for motor power.

Free chlorine is the gas that is most dangerous in a submarine, and since this is highly toxic the whole personnel could be rapidly overcome before measures could be taken to protect the crew.

Asphyxia from re-breathed air is another hazard that is reasonably common in the submarine. If the carbon dioxide concentration is not permitted to accumulate above 3 percent, or the oxygen to fall below 17 percent, there is little danger. Anything below or above these levels tends to bring on asphyxial symptoms.

Submarine and diving operations present problems that are of particular interest to our Service. In this field the Navy has performed pioneer work. The rescue of over 50 percent of the crew of the *Squalus* was effected through equipment perfected by the Navy. The current diving operations, incident to the salvage of this vessel, are directly dependent upon principles evolved by our research on the physiology of respiration as it relates to diving operations. This phase of the problem, relating to asphyxia, is of such importance from our viewpoint and of such timely interest as to merit detailed comment.

One lesson learned from our submarine accidents is the greater need of oxygen storage. In such an accident as befell the Submarine *S–4*, in 1927, fatal asphyxiation was naturally the end result, since rescue was not possible before the oxygen tanks gave out. With our present additional safety devices, if the submarine is located with promptness, we are able to supply air and oxygen to the ship, but if location takes a greater time than 72 hours, fatal asphyxia will result.

When considering asphyxia in submarines, we naturally think of it in connection with diving. The most common cause is carbon dioxide concentration in the diver's helmet. It was thought in previous times that this occurrence would be indicated by the diver's failing to answer his telephone, or a signal calling for more air. Also the danger signs, as far as the diver was concerned, were supposed to be a dizziness, an uncomfortable feeling or warmth, and a headache. These have recently been found to be the late signs, and not the early and important ones. We now know that due to nitrogen concentration throughout the tissues, which occurs when there is a concentration of carbon dioxide in the helmet, that there is a period of exhilaration experienced by the diver; that when engaged in conversation with the

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surface ship his answers are excitable and inconsequential; and that his concentration on the task to which he has been assigned is aimless. This we attribute to a nitrogen narcosis. This is the danger point and a warning of approaching asphyxia, and the man should be immediately brought to the surface. By waiting for the old signs many divers are brought to the surface in complete collapse and in danger of fatal asphyxia.

Asphyxia due to caisson disease is rather rare among divers, and is due to air emboli in the pulmonary circulation. The management of such an attack is the same as the treatment of bends, and calls for immediate recompression and administration of oxygen. Helium has been found to have a very definite place in this form of asphyxia. The inhalation of oxygen accelerates and washes the nitrogen out of the tissues, and the addition of helium to the mixture hastens the process decidedly. After that, the individual is decompressed at a proper rate.

I have referred at various times to the use of helium and the employment of oxygen for decompressing divers and treating compressed-air illness. From the treatment, very frequently, we have a rapidly progressive and severe asphyxia, which has been described before as an accumulation of gas emboli in the lungs. Such multiple emboli interfere with oxygenation of hemoglobin and prevent adequate filling of the left side of the heart. To counteract this type of asphyxia an effective technique, utilizing the recompression chamber, has been developed. Oxygen and helium is administered when the pressure has been raised to 2½ atmospheres, which is equivalent to a depth of 50 feet. At a pressure of 2½ atmospheres sufficient oxygen is taken up by the blood in physical solution to meet all demands of the tissues and, therefore, hemoglobin is not necessary as an oxygen carrier. It is thus possible to effectively treat severe types of oxygen deficiencies. It has also been determined that the 50-foot level is the optimum for the elimination of helium or nitrogen gas from the diver's body.

A survey of 168 dives carried on to a depth of 240 feet, during the current salvage operations, brought out several interesting facts. Asphyxia is, of course, the chief concern. Two factors, the accumulation of carbon dioxide and nitrogen narcosis, were found to impair the coordination of divers to the extent that simple tasks could be carried out only with great difficulty. Moreover, it was found impractical for divers to carry out work at this depth when breathing pure air. In the early stages loss of consciousness occurred not infrequently, and on several occasions the diver lost control of his air supply and was blown to the surface. Only rapid recompression and administration of oxygen saved the lives of these men.

As to the nature of nitrogen narcosis, it may be stated that beginning with about four atmospheres pressure, nitrogen acts as a depres-

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sant and produces symptoms comparable to those manifested in alcoholic intoxication, or to those associated with the excitant stage of anesthesia. While the operators on the surface ship were aware of the symptoms of nitrogen narcosis at a depth of 240 feet, they were surprised at this intensity, for the experimental work done in a chamber, with pressure equivalent to a depth of 240 feet, had produced reactions of considerable less severity. Further tests made it clear that the difference in intensity of symptoms between chamber and actual deep-sea diving could be attributed to the accumulation of carbon dioxide in the diver's helmet. The accumulation of carbon dioxide in the helmet causes the depressant or intoxicating effects of nitrogen to be more pronounced.

It is also likewise true that the toxic effect of oxygen at high pressures is intensified by raising the carbon dioxide tension in the lungs. Consequently, lowering the carbon dioxide tension by hyperventilation decreases these untoward symptoms. The substitution of helium for nitrogen minimizes, or abolishes, the narcotic symptoms associated with breathing air under pressure.

At the present time diving operations are carried out entirely by recirculating a mixture of helium and oxygen through the diver's helmet. While this procedure has been recently successful, it appeared for a time that accumulation of carbon dioxide, and oxygen lack, might prevent the salvage operations.

A nearly fatal accident occurred to a diver who developed asphyxial symptoms while breathing a helium-oxygen mixture at a depth of 240 feet. Following a period of vigorous work the diver suddenly lost consciousness and was blown to the surface. Under such conditions gas emboli rapidly form in the bloodstream, especially in the pulmonary vascular bed, to produce a severe asphyxia known among divers and caisson workers as chokes. The diver in this case, upon reaching the surface, was unconscious and presented a toxic cyanotic appearance. The immediate application of pressure in a chamber, together with oxygen therapy, restored consciousness in about 45 minutes. It can be safely stated that the Navy has developed an effective procedure for successfully treating asphyxia, incident to diving operations, by the administration of oxygen in a pressure chamber.

At this point I believe it will be of interest to comment briefly on ventilation in a submarine which has been cut off from the surface for any reason. At the present time oxygen supply is considered adequate for 72 hours. Carbon dioxide absorbent is also carried in sufficient quantity to care for that period. Approximately 450 cubic feet per man is allowed on our newer type submarines. We must provide an allowance of 0.6 cubic foot of oxygen per hour for each man, when he is at rest, and at the same time the carbon dioxide out-

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put is 0.5 cubic foot per hour per man. It will then be seen that without the use of carbon dioxide absorbent a concentration of about 3 percent of carbon dioxide would be reached in 12 to 15 hours. Consequently, future plans should include the provision for each ship to carry more oxygen and more carbon dioxide absorbent. It is readily seen that this is necessary in case a submarine might be unable to come to the surface and would require a longer time than 72 hours for location by the salvage vessels.

The danger of chlorine in a submarine cannot be overestimated; in fact, all ships should be supplied with masks for such protection. It is interesting to know that in the *Squalus* rescue, the survivors reached the surface in excellent physical condition. The only untoward symptoms were headache, in about one-third of the crew, and a few showed evidence of mild shock. The temperature being between 45° and 55° was the greatest hardship that the men were called upon to withstand. All of these men were given oxygen during the period of restoring body warmth, and all symptoms cleared at a very rapid rate.

The lesson learned at this time is the value of the knowledge we now have of the nitrogen narcosis. Here is a sign that is a definite preliminary warning of impending danger from carbon dioxide concentration. When symptoms of narcosis develop the man should be immediately brought to the surface, recompressed and given oxygen therapy. With rare exceptions then, the incidents of having men blown to the surface from great depths will be minimized and possible fatal accidents avoided.

If the Navy has done anything helpful at all in the prevention of asphyxial death, I believe its outstanding contribution is the improved methods of oxygen therapy.

It is my great hope that in the coming year we will be able to present to the medical profession satisfactory evidence of the use that helium plays in the treatment of asphyxia, and also what useful part it may play in the field of anesthesia.

U. S. S. SQUALUS

MEDICAL ASPECTS OF THE RESCUE AND SALVAGE OPERATIONS AND THE USE OF OXYGEN IN DEEP-SEA DIVING

By Lieutenant A. R. Behnke, Medical Corps, United States Navy, and Lieutenant T. L. Willmon, Medical Corps, United States Navy

PART I—RESCUE OF THE SQUALUS SURVIVORS

On the morning of May 23, 1939, preliminary preparations were already under way at the experimental diving unit, Navy Yard, Washington, D. C., to conduct diving tests in the vicinity of Portsmouth, N. H., beginning about June 7.

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For a period of 20 months the personnel of the diving unit under the supervision of Lieutenant Commander Momsen had been conducting laboratory experiments and tests in the pressure tank to ascertain the value of helium-oxygen mixtures in deep-sea diving.

At about 11:30 a. m., a critical experiment in a series designed to determine the level of maximum nitrogen elimination from the body during oxygen breathing was interrupted by the announcement "The *Squalus* is down off Portsmouth; stand by to leave within 2 hours."

Shortly after 2 p. m. the personnel of the unit, supplied with diving apparatus and tanks of helium left by airplane from Anacostia field for Portsmouth. Arriving at Portsmouth in the early evening, preparations were made during a cold, drizzly rain to rescue survivors of the disaster.

By means of temporary telephone communication, and then by tapping signals it was learned that the *Squalus*, flooded aft of the control room, was lying on a fairly even keel at a depth of 240 feet, 16 miles east of Portsmouth. In the control room and forward, 33 men were alive. The pressure in this part of the boat had built up to 13 pounds per square inch. Aft of the control room in the flooded portion of the ship, the fate of 26 men was unknown.

Diving operations were now contingent upon the arrival of the U. S. S. *Falcon* from New London. In the meantime, a submersible decompression chamber was sent to the scene of the disaster aboard a Coast Guard cutter to provide recompression for possible survivors escaping from the after end of the boat by means of the Momsen "lung."

Aboard the sister submarine *Sculpin*, which first sighted smoke bombs released from the sunken *Squalus*, Rear Admiral Cole and staff officers were making plans for the rescue of survivors.

Early the next morning, May 24, the *Falcon*, carrying the rescue chamber, arrived, and by 9:30 a. m. was moored over the sunken submarine.

Then occurred a series of remarkable operations, characterized by calm and faultless execution. All hands, conscious of the momentous task of rescue, worked in perfect unison.

Sibitzky, the first diver down, landed forward on the submarine, about 8 feet from the torpedo room hatch, where the downhaul cable of the diving bell was to be attached. His dive successful, the rescue chamber was started on its way to the submarine.

In the early afternoon, the first group of survivors was brought to the surface. These men appeared calm and relaxed. There was no evidence of hysteria. All were cold and some were in a condition of mild shock. About one-third of the survivors suffered from headache, undoubtedly the result of increased carbon-dioxide concentration.

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The development of bends, although the survivors had been subjected to an excess pressure of 13 pounds for over 30 hours, was extremely remote. The recompression chamber, however, was utilized to supply warmth, and, if necessary, for oxygen therapy. Medical treatment was directed toward maintaining absolute rest, and supplying heat and fluids, consisting of coffee and malted milk, to which liberal amounts of sugar were added.

Particularly effective were the hot towels placed over the upper abdominal and hepatic areas. Within a few hours, the survivors had recovered sufficiently so that they could be safely transported to Portsmouth Naval Hospital.

Shortly after midnight, or about 15 hours after the start of operations, the fourth and last group of survivors was brought to the surface. This last ascent of the diving bell was marred by the jamming of the downhaul cable and for more than 4 hours the survivors were trapped at a depth of 240 feet, unable to surface.

In the meantime, strands of cable leading from the rescue chamber to the *Falcon* began to part. Two divers failed to attach a new cable, and the task now resolved itself into severing the downhaul cable leading from the chamber to the submarine.

In successfully cutting the downhaul cable, Squire, the diver, had to descend to a depth of 220 feet in cold water (39° F.), enveloped by complete darkness. Moreover, breathing air at this depth induces in divers a condition of intoxication so that coordinated activity requires intense effort.

By the time that the downhaul cable was severed, the rescue chamber was suspended by a weakened safety cable. For fear of breaking this controlling wire by hauling with power machinery, officers and men under the direction of Commander McCann and Lieutenant Commander Momsen actually pulled the rescue chamber to the surface.

Rescue operations ended on the morning of May 25, when Badders and Mihalowski, descending in the rescue chamber to the after hatch of the submarine under a pressure of 108 pounds per square inch, reported that the torpedo room was flooded.

Meanwhile all of the survivors had been sent to the hospital and with the exception of three, were in good condition. Hospitalization served not only to prevent complications, particularly the development of pneumonia, but also to keep the survivors in a single group under naval surveillance.

Of conditions in the submarine prior to rescue, Lieutenant Naquin, the commanding officer of the *Squalus*, made the following comments:

> Every effort was made to conserve the energy of the men who spent a great deal of time sleeping. The men were instructed to remain calm as excitement would increase oxygen consumption and carbon dioxide output. The oxygen

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supply and available carbon dioxide absorbent were adequate for about 72 hours.[1]

The carbon dioxide concentration probably reached about 3 percent. One tank of oxygen was used in the control room (containing about one-half of the survivors) and another tank in the torpedo room. The intermediate battery compartment was not inhabited since it was feared that chlorine gas might be generated as a result of entrance of sea water into the storage batteries. After a number of hours the odor of chlorine was detected in this compartment, and the men wore "lung" appliances converted into chlorine protectors enroute from the control room to the torpedo room, where escape into the diving bell was effected.

Carbon dioxide absorption was facilitated by spreading absorbent throughout the compartments. A noticeable improvement in respirability followed each fresh addition.

Except for the men engaged in communicating with surface vessels by tapping signals, there was no activity on the part of any of the survivors, who remained in the same positions throughout the period prior to rescue (28 to 40 hours).

With respect to food, the emergency ration of beans was eaten by only a few and in small quantity. The men particularly relished and ate almost exclusively canned pineapple, tomatoes, and peaches, which were available in the commissary storeroom. Fluids were derived entirely from the canned goods, as the fresh water supply in the control and torpedo rooms, although potable, had an unpleasant taste.

The atmosphere in the submarine was dark, cold, and moist. The men suffered acutely from cold, which was only partially relieved by eating.

It is apparent that the survivors while awaiting rescue consumed a minimum amount of oxygen. The remarkable discipline present under trying conditions certainly prevented the early occurrence of oxygen lack and high carbon-dioxide increase.

The atmospheric conditions in the submarine were, however, not conducive to effort. The men existed in a dark atmosphere, saturated with moisture at a temperature between 45° and 55° F. Moreover, they were under a pressure of 13 pounds per square inch. It was impossible to keep warm even with blankets as the body heat was rapidly lost through conduction in the moist atmosphere.

The communicators especially were taxed severely in their efforts to send and to receive messages. In fact, any exertion caused great discomfort.

The maintenance of an adequate oxygen concentration and the limitation of carbon-dioxide content were so well directed by the commanding officer that life in the compartments could have been maintained for at least 72 hours.

PART II—SALVAGE OPERATIONS

The *Squalus* disaster provided a crucial test for the preparation embodied in a long period of experimentation and training incident to

[1] An allowance roughly of 0.5 cubic foot per hour is made for the carbon-dioxide output and about 0.6 cubic foot per hour for oxygen consumption by men at rest. In this type of submarine the available air space is approximately 450 cubic feet per man. According to the manual of the Bureau of Construction and Repair, the limiting concentration of carbon dioxide is set at 3 percent, and of oxygen at 17 percent. Without adding oxygen or absorbent for carbon dioxide, such limiting concentrations would be reached in from 12 to 15 hours if the men were moderately active or in 24 to 30 hours if the men remained at rest.

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submarine rescue and salvage operations. These developments have been engineering and medical in scope.

The engineering accomplishments include the raising of the submarines *S–51* and *S–4*, and the development of the rescue chamber and the submarine escape appliance (the "lung").

Coincident with these advances have been physiologic studies and experiments providing quantitative data as to the effects of pressure and of gases under pressure on personnel. These studies participated in by naval medical officers at the Harvard school of public health and at the experimental diving unit have centered in the introduction of a simple and effective method of utilizing oxygen in the decompression of divers, in the application of oxygen therapy for the treatment of compressed-air illness, and in the employment of helium-oxygen mixtures for work at depths in excess of 150 feet.

It remained, however, to test newly acquired knowledge and recently developed methods of procedure by actual deep-sea diving. A sunken submarine at a depth of 240 feet unfortunately provided the test.

Although 6 weeks of engineering and diving effort was nullified when the bow of the *Squalus* emerged from the water on July 13, nevertheless the diving operations were satisfactory. For without effective diving the involved engineering feat of placing pontoons, and of reeving chains under a submarine could not have been accomplished.

The diving record is further unique in that from May 24 to August 1, 372 dives were made without the occurrence of a single case of bends. Several accidents in which divers losing consciousness on the bottom and blown to the surface, were treated effectively by compression and oxygen therapy.

In contrast with previous diving methods, the distinguishing features of the diving technic were the successful employment of helium-oxygen mixtures for deep diving in cold water, made necessary by the failure of the standard method using air, and the effective use of oxygen permitting the decompression of divers without injury.

Of the engineering innovations relative to diving, several were especially important, namely, the fabrication of fireproof, electrically heated garments for cold-water diving, improved recirculation of gas through the diver's helmet, and the perfection of telephone communication.

Diving on air.—Since helium diving was still in the experimental stage at the beginning of salvage work, it was deemed advisable to follow the accepted method of air diving.

In previous salvage operations on the *S–51* at a depth of 132 feet and on the *S–4* at a depth of 104 feet, air diving was effective although the incidence of bends was high.

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Diving in semidarkness, however, to a depth of 240 feet for the purpose of tunneling under the submarine and attaching hoses proved to be too dangerous when the divers breathed air. Two factors, the accumulation of carbon dioxide, and nitrogen narcosis impaired neuromuscular coordination to the extent that simple tasks could be carried out only with great difficulty.

The responses of the divers were marred by lapses in memory and loss of consciousness. On one occasion, the diver losing control of his air supply was blown to the surface. It was not only dangerous but futile for divers with impaired faculties to work at a depth of 240 feet in a maze of hoses and cables. The confusion of the divers is apparent from the following statements made by them:

I found the after torpedo room hatch, then went to the starboard rail and forward about 15 feet. At this time thinking became difficult. I started to tie the descending line to the rail and suddenly realized that I was just waving my arms and not accomplishing anything. Managed to steady down and tied what I believed to be two half hitches. I had a moment of blankness; when I observed the knots again, was surprised to see that I had made several turns with the line and had tied clove hitches and then half hitches. Heard order to come up. Went up on descending line outside of rail and waited to be pulled up. Was told I was fouled and to get back on submarine. Got back and faintly remember starting up again and being pulled up.

(Diver lost cable due to incoordination and asked that it be sent down to him again.) I waited for the cable to be sent down again; this time I cut it loose and made sure it was clear of the descending line, walked aft along the rail to the hatch, and put the shackle down against the pin. After feeling for the pin for some time, lying pretty close to the deck (because of poor visibility) with my air cut a little low, I saw slight moisture on my face plate (early carbon dioxide indication) and hadn't discovered the location of the pin.

I got on my feet, opened the exhaust another turn, opened my air, cleared the face plate. I looked over the shackle and saw the pin in the shackle, where I had been told it would be.

After discovering the pin, I laughed out with joy, and mumbled a few words intended for myself, but loud enough for the topside to hear. I could tell the way the topside was asking, "Was I all right," that they were worried about me. Told topside that I was O. K. and now knew what I was doing."

I made a normal descent, but as I started to get aboard the submarine I had a turn around my leg with the descending line. Had to struggle a bit to get it clear. Got on the submarine, called topside and reported. Did not hear any answer. I am not sure but I think that I asked them if they heard me, to give me the telephone signal on my life line. I must have lost consciousness for the next thing I remember is that I was jerked up off the submarine. I must have had control of myself on the way up, for when I regained consciousness I had the control valve in my hand.

As to the nature of nitrogen narcosis it may be stated that beginning at about 4 atmospheres' pressure (100 feet) and increasing progressively, nitrogen acts as a depressant to produce symptoms comparable

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to those manifested in alcoholic intoxication or to those associated with the excitement stage of anesthesia.[2 3 4 5]

While we were aware of the symptoms of nitrogen narcosis at a depth of 240 feet, we were surprised at their intensity. For the application of pressure in a chamber equivalent to a depth of 240 feet elicits reactions of considerably lessened severity.

Additional diving tests indicated that the difference in reactions between chamber and deep-sea diving could be attributed to the increase in carbon dioxide concentration in the diver's helmet.

The symptoms, however, were not typical of high carbon dioxide tension in the lungs but rather of air at a depth of 300 feet or more. Increased depth of respiration, for example, did not precede loss of consciousness.

Apparently the increase in carbon dioxide augmented the narcotic action of nitrogen.

As a possible explanation of this phenomenon we refer to the dilatation of cerebral vessels when the carbon dioxide tension is increased in the lungs.[6] Presumably as a result of increased vascularity more nitrogen will diffuse into brain tissue per unit of time.

It is likewise true that the toxic effects of oxygen at high pressures are intensified by raising the carbon dioxide tension in the lungs.[7] Conversely, lowering the carbon dioxide tension by hyperventilation decreases the untoward symptoms.

HELIUM-OXYGEN DIVING.—The substitution of helium for nitrogen in the air minimizes the narcotic symptoms associated with air breathing under pressure.[3 4 5] To divers accustomed to breathing air under pressure, the use of helium afforded considerable relief. The following statement from a diver was typical:

> This dive (on helium) was the best dive I have ever experienced. I did not feel deeper than 50 feet at any time; my head was clear and my mental faculties were working well at all times.

It may be of interest to record that the helium supplied to the *Falcon* was shipped from Lakehurst in cylinders containing about 1.5 cubic feet under a pressure of 2,000 pounds. At the Portsmouth Navy Yard, helium and oxygen cylinders were "split" and the gases mixed

[2] Behnke, A. R., Thomson, R. M., and Motley, E. P., Psychologic effects from breathing air at 4 atmospheres' pressure, Am. J. Physiol. 112: 554–558, July 1935.

[3] Behnke, A. R., and Yarbrough, O. D., Physiologic studies of helium, U. S. Nav. M. Bull. 36: 542–558, Oct. 1938.

[4] Behnke, A. R. and Yarbrough, O. D., Respiratory resistance, oil-water solubility, and mental effects of argon, compared with helium and nitrogen. Amer. Journ. Physiol. 126, June 1939.

[5] End, E., Rapid decompression following inhalation of helium-oxygen mixtures under pressure. Am. J. Physiol. 120: 712–718, Dec. 1937.

[6] Behnke, A. R., Forbes, H. S., and Motley, E. P., Circulatory and visual effects of oxygen at 3 atmospheres' pressure, Am. J. Physiol. 114: 436–442, Jan. 1936.

[7] Shaw, L. A., Behnke, A. R., and Messer, A. C., Role of carbon dioxide in producing symptoms of oxygen poisoning, Am. J. Physiol. 108: 652–661, June 1934.

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to give cylinders containing about 75 percent helium and 25 percent oxygen. Analysis of the gas composition was performed in a laboratory set up near the dock.

After allowing several days for complete mixing, the cylinders were transported to the *Falcon* and set up in a manifold from which a hose led to the diver's helmet.

In the diving helmet the gas was recirculated through carbon dioxide absorbent by means of an aspirator. The aspirator or circulator is an ingenious mechanism working on the same principle as a water suction pump and consisting of a tiny jet facing into a venturi tube. The flow of a small volume of gas through the jet at an excess pressure of 150 pounds aspirates gas from the helmet into the container filled with carbon dioxide absorbent. The recirculating system has a high efficiency, as only about one-fifth of the gas supply is necessary compared with the open circuit.

Without an efficient method of recirculation the use of helium is not practical. On one occasion before adjustments were made in the helium supply to the helmet, a diver developed asphyxial symptoms at a depth of 240 feet and was blown to the surface. Under such conditions gas emboli rapidly form in the blood stream and accumulate in the pulmonary bed to produce a severe asphyxia known among divers and caisson workers as the chokes. Recovery followed oxygen administration in the pressure chamber. [8]

DECOMPRESSION OF DIVERS.—The problem inherent in bringing divers to the surface is to provide for the elimination of excess gas dissolved in the body tissues without bubble formation.

The history of diving, however, is marred by faulty methods of decompression giving rise to gas embolism and the resulting symptoms of pain, asphyxia, and paralysis.

If we could keep a diver under pressure and at the same time effect the removal of gas from his tissues, and if, in addition, the major part of decompression could be carried out in a pressure chamber on the surface, then our problem would be solved.

These objectives were accomplished in the decompression of divers aboard the *Falcon* by the administration of oxygen in a recompression chamber at the 50-foot level following comparatively rapid ascent to the surface.

Essentially the substitution of oxygen for air or the helium-oxygen mixture in the lungs allows excess nitrogen or helium gas to diffuse from the body at a maximum pressure head; and the maintenance of pressure at two and one-half atmospheres (50-foot level) prevents bubble formation.

[8] Yarbrough, O. D., and Behnke, A. R., Treatment of compressed air illness utilizing oxygen, Journ. Ind. Hyg. and Toxicology 21: 213-218, June 1939.

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A diver, for example, following a 20-minute working period at a depth of 240 feet, surfaced in 15 minutes, stopping only at the 80, 60, and 50-foot levels. He was then taken to the recompression chamber and given oxygen to breathe for a period of 45 minutes following which it was safe to effect his return to normal atmospheric pressure.

Bringing a diver rapidly to the surface for subsequent recompression, or surface decompression as the practice is usually designated, was forced upon diving personnel in the salvage of the *S–51* in 1925 because cold water and tides rendered decompression in the open sea impracticable. The procedure permits the elimination of excess gas from the body tissues under ideal conditions, that is, with the diver warm, at rest, and under observation. The danger of the method lies in the formation of extensive gas embolism during the interval between surfacing the diver and his subsequent recompression.

During the 15-minute period in the water, however, the high-pressure head of helium in the blood stream and body fluids is lowered to the point where it is safe to bring the diver to the surface provided recompression is applied within several minutes.

Should bubbles begin to form in the interval period, recompression to the 50-foot level with the diver breathing oxygen brings about a resolution of bubbles and promotes a maximum elimination of gas as previously determined by laboratory measurements.

In sharp contrast to the novel practice of effecting decompression by breathing oxygen at a single, optimum level, is the procedure followed in previous salvage operations (*S–51*, *S–4*) of breathing air in carefully graded stages during the diver's stay in the pressure chamber. The assumption underlying this method is that the body tissues can hold gas in supersaturation for an extended period of time to permit the pressure to be lowered in stages. Diffusion of excess dissolved gas from the body under these conditions is precarious because of the imminent probability of bubble formation as a result of the higher pressure head of gas in the body compared with the lungs.

The problem of administering oxygen economically in the recompression chamber has been solved by adopting the mask developed by Boothby and his coworkers. The divers were able to wear this appliance without discomfort, and the fractional rebreathing of oxygen prevented irritating dryness of the throat frequently complained of when oxygen is breathed in an open circuit.

By administering oxygen only to the diver by means of a mask, the fire hazard is minimized. Were it necessary to fill the chamber with oxygen under pressure, the fire hazard would preclude oxygen therapy from further consideration.

THE ELECTRICALLY HEATED SUIT.—The hazards of decompression are greatly increased by exposure in cold water. Especially subject to

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cold are divers breathing and surrounded by a helium atmosphere in which presumably body heat is more rapidly dissipated through conduction than it is in an air atmosphere.

To counteract the harmful effect of cold, predisposing as it does to bends and preventing efficient manipulation of the hands, a manufacturer, carrying out suggestions from the experimental diving unit, fabricated a fireproof, electrically heated garment. The heat supply, controlled from the surface, comes from storage batteries.

Wearing these garments the divers were comfortable not only while working on the bottom but also while standing on the stage during decompression.

VOICE CHANGES.—The peculiar nasal quality imparted to the voice by helium is not improved at deep depths, indicating that the density of the helium-oxygen mixture is not responsible for the sound distortion.

So serious was the impaired audibility of the diver's conversation over the telephone that it became imperative to improve sound equipment. As a result of efforts to improve communication, sound reception from the telephone when the diver was at a depth of 240 feet was rendered as clear as at the surface.

EQUALIZATION OF PRESSURE.—For a period of 6 weeks in which over 200 dives were made, divers did not have any difficulty equalizing pressure on the tympanic membranes. About the middle of July, however, upper respiratory tract infection sealing the auditory tubes prevented as many as six divers from working in a single day. Whether air or helium mixture was breathed apparently made little difference in the ability to equalize pressure.

PART III.—PHYSIOLOGIC BASIS FOR OXYGEN ADMINISTRATION IN DEEP-SEA DIVING

In view of the increasing scope of oxygen administration, and its proved value in deep-sea diving, it may be well to review briefly some of the physiologic studies of oxygen effects at increased pressures.

In theory oxygen would be an ideal gas for deep-sea diving since bubbles forming in the body after decompression would be quickly absorbed by the tissues.

In practice, however, pure oxygen has been found to be toxic, producing symptoms referable to the lungs and the nervous system. At a pressure of one atmosphere after prolonged exposure pulmonary edema develops in rats, dogs, and rabbits. At a pressure of 4 atmospheres convulsive seizures signalize the most striking phenomenon of oxygen poisoning.[9] [10]

[9] Behnke, A. R., Johnson, F. S., Poppen, J. R., and Motley, E. P., Effect of oxygen on man at pressures from one to four atmospheres, Am. J. Physiol. 110: 565–572, Jan. 1935.

[10] Schilling, C. W., and Adams, B. H., Study of convulsive seizures caused by breathing oxygen at high pressures, U. S. Nav. M. Bull. 31: 112–121, April 1933.

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While the exact nature of oxygen poisoning is a matter of conjecture, of great importance is the time elapsing before toxic symptoms appear. On the basis of animal experiments at least 24 hours were required before pulmonary edema developed, and at a pressure of 4 atmospheres about 45 minutes elapsed before convulsions were manifest.

Although the tolerance of various animals to high oxygen pressures had been established, the problem in 1932 called for tolerance tests in man. From these tests conducted by naval medical officers at the Harvard school of public health, it was found that at atmospheric pressure healthy men could breathe oxygen for a period of at least 6 hours without showing symptoms indicative of pulmonary irritation. At higher pressures the effect of oxygen on the nervous system superseded the pulmonary manifestations.

At a pressure of 3 atmospheres, for example, definite and sometimes alarming symptoms occurred during the fourth hour of oxygen inhalation.[6] Preceded by a period of normality and with fairly abrupt onset, a rise in blood pressure, increase in pulse rate, and contraction of visual fields terminating in loss of vision, pointed to the action of oxygen on the nervous system.

Although loss of vision and an epileptic type of seizure pointed to a severe functional disturbance, complete recovery invariably followed these symptoms when air was again breathed.

From these tests developed several facts worthy of emphasis, namely, that the harmful effect of oxygen on the nervous system begins to manifest itself at a pressure of 3 atmospheres, at which level the oxygen in physical solution is sufficient to take care of tissue requirements and hemoglobin is not necessary as an oxygen carrier;[11] that the nervous symptoms, therefore, are concomitant with the building up of the oxygen tension in venous blood; that 1.8 volumes percent of oxygen are dissolved in arterial blood per atmosphere of oxygen; that the acidity of the venous blood is increased by a pH change of 0.03 when pure oxygen is inhaled; and that increasing the carbon dioxide tension in the lungs greatly enhances the toxicity of oxygen.[7]

Successive daily exposures to induce convulsions were then carried out by placing dogs in a chamber and raising the pressure to 5 atmospheres. After 30 exposures residual injury could not be detected.

On the basis of these observations, although the cause of oxygen toxicity was not determined, it appeared justifiable to use high oxygen pressures for the treatment and prevention of compressed-air illness.

Oxygen therapy was then evaluated in compressed-air illness. In a series of tests on dogs rapidly decompressed from a pressure of 65 pounds, multiple emboli formed throughout the vascular system,

[11] Behnke, A. R., and others, Studies on effects of high oxygen pressure; effect on high oxygen pressure upon carbon dioxide and oxygen content, acidity, and carbon dioxide combining power of blood, Am. J. Physiol. 107: 13-28, Jan. 1934.

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blocking blood flow, and unless treatment supervened, produced death by asphyxiation, due to nitrogen bubbles obstructing blood flow through the pulmonary capillaries.

The administration of oxygen in a chamber at a pressure of 30 pounds compressed the bubbles and relieved the asphyxia.[12]

Later, at the experimental diving unit, recompression utilizing oxygen was employed to treat injured divers. Out of 50 patients suffering from bends, 49 responded to the initial treatment without recourse to additional pressure therapy.[8]

With respect to the decompression of divers, rational oxygen administration depends upon the determination of the pressure level at which maximum diffusion of nitrogen or helium takes place from the body following exposure to increased pressure.

At the present time experiments in which gas measurements were made in a pressure chamber have progressed sufficiently to indicate that the most favorable level ranges between 50 and 60 feet.

At pressures equivalent to these depths oxygen is well tolerated, at least for a period of time sufficient to eliminate excess nitrogen or helium regardless of previous depth or exposure.

Taking these facts into consideration, it has been possible in the decompression of divers to bring them rapidly to the 50-foot level where they remain breathing oxygen until the excess gas pressure in the body has decreased, as shown by experimental graphs, to the point where immediate surfacing is safe. Thus, the complicated and precarious practice of decompression has evolved into a simple and effective procedure.

OXYGEN [1]

IMPORTANCE OF OXYGEN TO THE NAVY IN AVIATION AND IN THERAPEUTICS

By Walter M. Boothby, M. D., Section on Metabolic Investigation, W. Randolph Lovelace, II, M. D., Fellow in Surgery, The Mayo Foundation, and Lieutenant Hubert H. Carroll, Medical Corps, United States Navy, on assignment to The Mayo Foundation

The development by Boothby,[2] Lovelace [3] and Bulbulian [4] of a new inhalation apparatus for the comfortable, economical, and efficient administration of oxygen in any desired concentration up to 100 percent has opened up new fields for oxygen therapy and has increased greatly the practicability and the value of the administration of oxygen not only in the field of medical therapeutics but also in the field of aviation.

[12] Behnke, A. R., and Shaw, L. A., Use of oxygen in treatment of compressed-air illness, U. S. Nav. M. Bull. 35: 61-73, Jan. 1937.

[1] From the Mayo Foundation, Rochester, Minnesota.

[2] Boothby, W. M., Oxygen administration: value of high concentration of oxygen for therapy, Proc. Staff Meet., Mayo Clin. 13: 641-646, Oct. 12, 1938.

[3] Lovelace, W. R., II., Oxygen for therapy and aviation: apparatus for administration of oxygen or oxygen and helium by inhalation, Proc. Staff Meet., Mayo Clin. 13: 646-654, Oct. 12, 1938.

[4] Bulbulian, A H., Design and construction of masks for oxygen inhalation apparatus, Proc. Staff Meet., Mayo Clin. 13: 654-656, Oct. 12, 1938.

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FIGURE 7.—NASAL TYPE B. L. B. OXYGEN INHALATION APPARATUS.

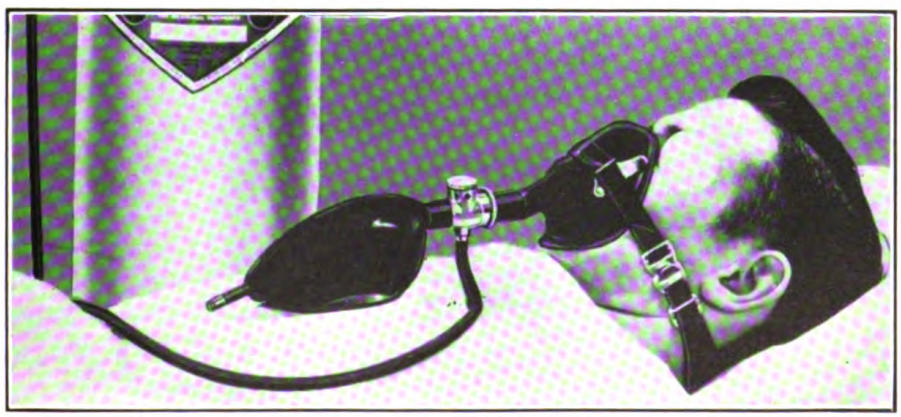


FIGURE 8.—ORONASAL TYPE B. L. B. OXYGEN INHALATION APPARATUS.

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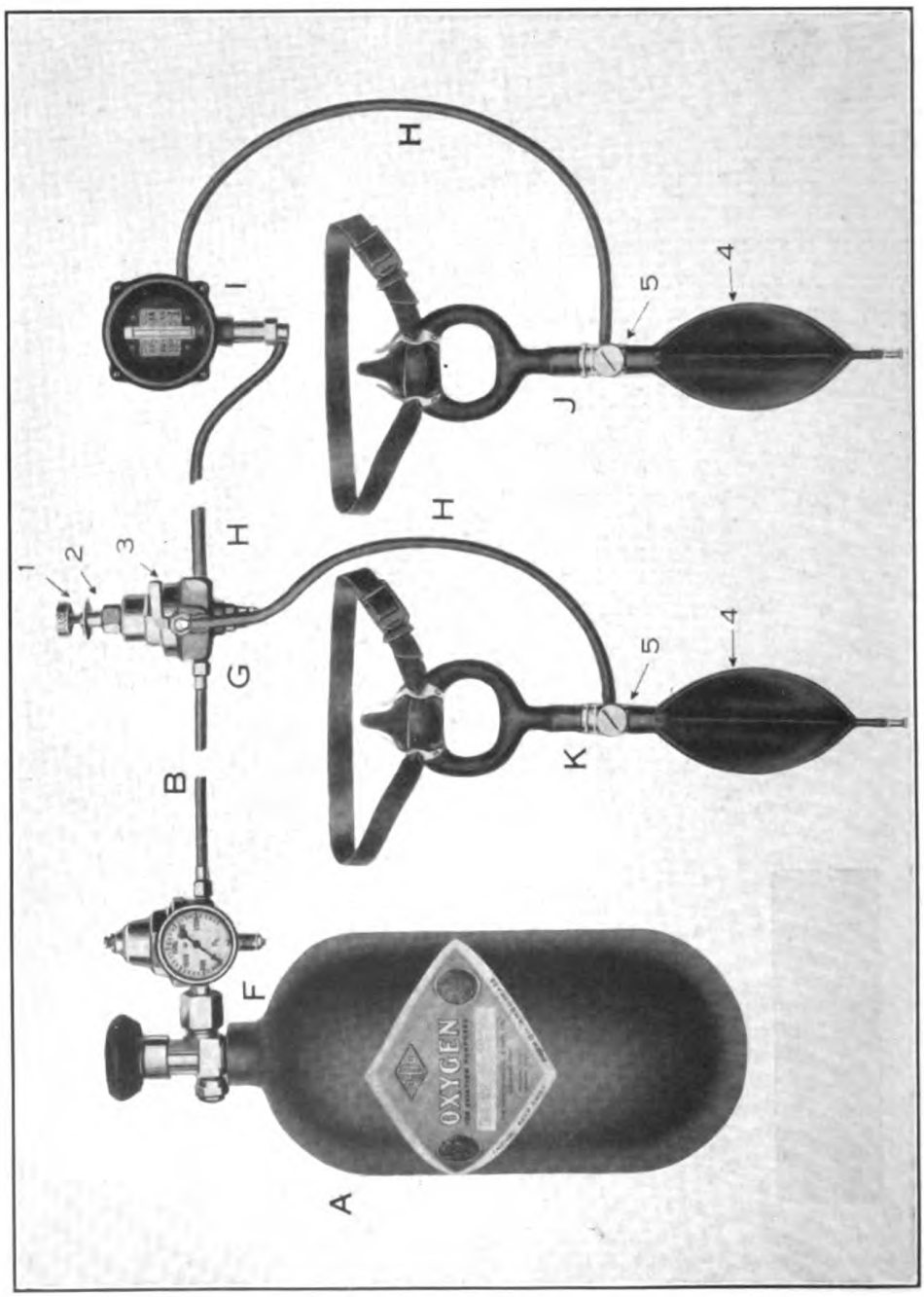


FIGURE 10.—B. L. B. OXYGEN INHALATION APPARATUS, STANDARD UNIT FOR AVIATION.

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OXYGEN THERAPY

For the Navy, in the field of therapeutics, it will be practicable to provide efficient oxygen therapy not only in the regular hospitals but also on board even the smallest ships of the fleet. The ability to administer 100 percent oxygen in a practical manner on shipboard will so broaden the field of application in the Navy that many lives will be saved both in peace and in war. In this paper, therefore, we will attempt to present the indications for and uses of oxygen therapy as they exist at sea and refer the reader to our other papers for the uses which will be more frequent ashore.

Practically all ships of the fleet carry a large supply of oxygen for oxywelding repair work although the amount carried will have to be increased to supply a sufficient amount for therapy. However, we feel that the development of a small, portable, compact device for administering oxygen up to a concentration of 100 percent has opened up a wide field of therapeutic possibilities aboard ship, some of which may be actually lifesaving at times.

OXYGEN INHALATION APPARATUS

The B. L. B. oxygen inhalation apparatus consists of three parts: the mask, the connecting-regulating device, and the reservoir-rebreathing bag.

THE MASK.—Two types of interchangeable masks are provided. One nasal type (fig. 7), which leaves the mouth free for eating or drinking and also permits, in an airplane, the free use of the radio; the other, an oronasal type (fig. 8), which covers both the nose and mouth for use on individuals who are mouth breathers, as is often the case with patients who are unconscious. Because the basic design conforms to the underlying bony structures, which are less variable than the soft overlying tissues, it was necessary to provide only two sizes of each type of mask. When properly adjusted with the rubber retaining strap, the mask is comfortable and can be worn for hours or days.

THE CONNECTING-REGULATING DEVICE.—A metal connecting and regulating device connects the mask to the reservoir-rebreathing bag. The oxygen inlet tube passes through this metal device, turns downward and conducts the oxygen into the lower part of the bag. It is provided with a rotating sleeve that contains three small openings which can be brought into apposition with similar openings in the main tube by turning the sleeve.

When it is desired to administer 100 percent oxygen these portholes are closed and 6 to 8 liters of oxygen per minute are used, enough to keep the reservoir-rebreathing bag from completely collapsing; when

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desired to dilute the oxygen with air and to administer 50 to 60 percent oxygen, two portholes are left open and only 4 liters of oxygen are used per minute.

In addition, there is an expiratory valve with a spring under light tension which permits the escape of the expired air over and above that just sufficient to distend the reservoir-rebreathing bag without causing any appreciable resistance to expiration. By adjusting the portholes and by regulating the flow of oxygen from the oxygen tank, any desired proportion of oxygen or oxygen-helium mixture and air can be administered. Recently a connecting and regulating device has been developed that requires no adjustment for the various concentrations of oxygen either in therapy or aviation. Experiments are under way to eliminate the danger of moisture from the exhaled air at very low temperatures.

THE RESERVOIR-REBREATHING BAG.—The reservoir-rebreathing bag is of such a size that it will contain slightly less than the volume of one expiration under the conditions in which the apparatus is being used. For practical purposes a bag of 500 cc. can be used in nearly all instances. The primary object of the bag is to conserve the oxygen which is flowing continuously from the tank during expiration (which phase usually requires two-thirds of the respiratory cycle) for inhalation on the following inspiration. The bag also increases the efficiency of the apparatus in the utilization of oxygen because it collects, in addition to the oxygen flowing in from the oxygen tank, the first part of the expired air which comes in large part from the "dead space" of the upper portion of the respiratory tract and which contains the largest amount of oxygen and the least amount of carbon dioxide. There is always less than 1 percent of carbon dioxide in the total inspired air. Enough moisture is present in the bag from the previous expiration to provide a comfortable humidity.

ACCESSORY APPARATUS FOR OXYGEN THERAPY.—Any standard make of reducing valve and flowmeter made by a reputable firm can be used when attached to the ordinary commercial cylinder of oxygen. However, a small, light, one-stage reducing valve can be used for oxygen therapy, because the change in pressure in the supply tank from the small amount of oxygen used will not materially influence the rate of delivery to the patient in the ordinary intervals of time between inspections of the patient by the attendant. To conserve space on shipboard several outlets can be arranged on each reducing valve; the rate of flow to each patient is then controlled by a separate needle valve and is measured by a separate flowmeter. The float type of flowmeter is preferable to the pressure types for therapeutic work, especially if a one-stage reducing valve with several outlets is used. The flowmeter should be calibrated in liters and the range should be from 1 to 12 liters per minute. A high pressure gauge should be a

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part of the reducing valve assembly in order to indicate the amount of oxygen in the tank.

The uses of the oxygen inhalation apparatus aboard hospital ships are multiple and include all of those uses to which it could be put in a hospital ashore. However, the features which make the oxygen inhalation apparatus even more acceptable for use aboard a hospital ship than in a shore establishment are its small size and ease of operation. Oxygen tents are bulky and occupy much space, and the economy of space necessary in a hospital ship does not permit of many compartments where oxygen tents could be satisfactorily used. In using the oxygen inhalation apparatus, no more room than the patient's bunk is required; if necessary, oxygen could be administered to both men in a double decker bunk at the same time. The tank can be secured to a convenient bulkhead or stanchion or lashed in the horizontal position on the deck. Of course, care should be exercised that the reducing valve and flowmeter are protected from injury.

NURSING ATTENTION

Whenever the attendant passes by the patient, he should glance at the reservoir-rebreathing bag; if it is not functioning, only a moment is necessary to adjust the mask properly. To keep the patient comfortable, the mask should be removed at intervals of about 2 hours and the patient's face should be washed, the skin dried and talcum powder applied.

Due to its simplicity of operation, the method can be taught easily and quickly to pharmacist's mates or even to nonmedical personnel, thus permitting good treatment, even on ships which carry no medical officer, until transference to a hospital ship or base is possible. While not so spectacular as a transfusion, on a large scale it will be much more practicable and probably more efficient. Of course, where facilities for transfusion are available, both methods should be used if indicated.

INCREASED VALUE OF 100 PERCENT OXYGEN

When pure oxygen is breathed, the blood in the capillaries of the pulmonary alveoli is exposed (at sea level) to a partial pressure of 673 mm. of oxygen (760 mm. minus 47 mm. for the water vapor and minus 40 mm. for the carbon dioxide). The hemoglobin will be almost if not completely, saturated and will contain 20 cc. of oxygen per 100 cc. of blood instead of the usual 19.2 cc. that is present when air is breathed. The amount of oxygen in solution in the plasma will also be increased from 0.3 cc. to approximately 2.1 cc. per 100 cc. of plasma. The arterial blood, therefore, will then contain a total of more than 22 cc. of oxygen per 100 cc. of blood instead of the usual 19.5 cc. that is present when air is breathed, or an increase of between 10 and 15

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percent over that which it contains when air is breathed. Although this increased amount of oxygen in the arterial blood amounts to only 10 or 15 percent, when this blood arrives in the tissues it may produce more than a 50 percent increase in the partial pressure of oxygen in the tissues.

Under normal conditions of the circulatory system, the blood as it passes through the capillaries of the tissues gives up only about 40 percent of its oxygen content. However, when the rate of circulation becomes very slow, as it does in collapse or shock, the blood gives

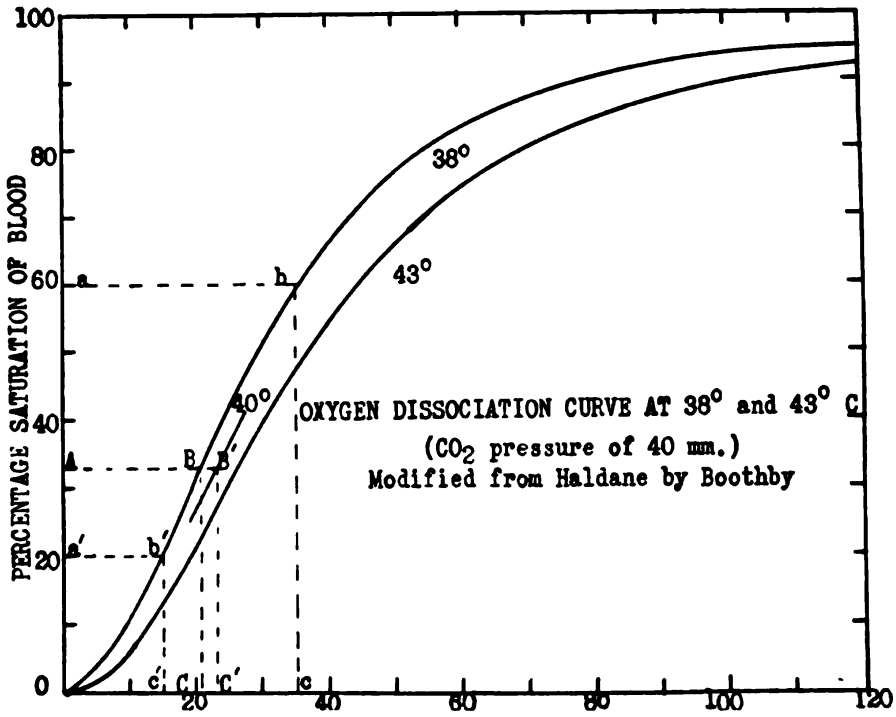


FIGURE 9.—Oxygen dissociation curve

up 80 percent or more of its original oxygen content. Under normal conditions, the partial pressure of oxygen in the capillaries is equivalent to 35 mm. of mercury, as shown by the lines *a*, *b*, *c*, in figure 9. When the circulation is slowed, the pressure is reduced to 14 mm. or less, as indicated by the lines *a'*, *b'*, *c'*.

Now, if nothing else is done except to have the patient inspire 100 percent oxygen, the arterial blood leaving the lungs will contain 22 cc. of oxygen per 100 cc. of blood or 10 to 15 percent more oxygen and the partial pressure of oxygen in the capillaries will be increased from 14 to 21 mm. as shown by the lines A, B, C. Therefore, the percentage increase in the oxygen pressure in the tissues that will be produced is very great, sometimes more than 50 percent.

The use of 100 percent oxygen, therefore, is of very great benefit in the treatment of circulatory collapse and shock. It should be used in

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conjunction with all the other commonly used methods of treating shock; those other methods, however, indirectly aim to increase the oxygen tension in the tissues. Although the administration of 100 percent oxygen is the most specific and one of the most effective of all the methods of treating shock, no method that is available should be neglected.

OXYGEN THERAPY ABOARD SHIP

COLLAPSE AND SHOCK FROM INJURY.—Even in time of peace it occasionally happens that a man is severely injured aboard ship while at sea and far from shore or hospital ship. In cases of severe injury with resultant shock, it has been possible aboard our larger ships to render very satisfactory treatment, and to employ all efficacious measures to combat shock, even including blood transfusion. On destroyers, submarines, tugs and ships of this class a transfusion is out of the question, and it is in the treatment of shock under such conditions that the use of 100 percent oxygen would be particularly valuable.

Shrapnel wounds and bullet wounds produce great destruction in the tissues, and the arterial and venous blood supply may be severely impaired. After a major engagement, little more in the way of therapy can be done than to decrease collapse and shock by the administration of 100 percent oxygen. In addition, the increased amount of oxygen will aid in preserving the injured part, and in the case of an injured extremity, if the circulatory injury is not too extensive, it will help prevent loss of the limb. With improved oxygenation of the injured tissue, secondary infection is less likely to develop, especially infection of the anaerobic type, such as tetanus and gas gangrene.

In civil as well as in military surgery, oxygen unfortunately has been looked on as a therapeutic measure of last resort. It is the custom of C. W. Mayo [5] to administer 100 percent oxygen immediately after operation to all patients who are subjected to an extensive surgical procedure. This routine procedure, in conjunction with transfusion in the most severe cases, unquestionably has been beneficial to these patients. Although it is impossible to say in what percentage such measures have been lifesaving, there is no doubt that convalescence of patients so treated has been much more comfortable and satisfactory. Although in military surgery, especially at sea, oxygen cannot be used as extensively as in civil surgery, it should be possible to exert equal care at the large base hospitals at home.

Although gas gangrene and tetanus are not such frequent complications in the Navy as they are in the Army, they do occur among the naval personnel. The use of 100-percent oxygen immediately

[5] Boothby, W. M., Mayo, C. W., and Lovelace, W. R., II., (Unpublished data).

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after injury will tend to prevent the development of these complications. In the treatment of these conditions after they are fully developed, 100-percent oxygen always should be used, if available. The subcutaneous emphysema is due to the formation of hydrogen by the gas bacillus; with the patient breathing air, nitrogen diffuses into the emphysematous area from the blood stream and causes still further distention. The inhalation of 100-percent oxygen quickly removes the nitrogen from the blood; then as the blood passes through the capillaries it will absorb the nitrogen as well as the hydrogen, carry it to the lungs and then give it off in the same manner as carbon dioxide is transported from the tissues to the lungs and is there eliminated. The process of elimination of nitrogen, however, is slower than that of carbon dioxide, as there are no "chemical carriers" for nitrogen in the blood. The increased oxygen pressure developed in the tissues first slows down and then finally stops the growth of this anaerobic organism. Even extensive emphysema can be largely removed in 24 hours.

Administration of 100-percent oxygen in conjunction with tetanus antitoxin undoubtedly will reduce greatly the danger of this infection.

The treatment of the collapse and shock as well as some of the other serious complications of major gunshot wounds by means of inhalation of 100-percent oxygen is one of the most efficient and direct methods for the purpose. It is fortunate, therefore, that the method is practicable for use at sea.

ACUTE ABDOMINAL DISTENTION.—When at sea, acute abdominal distention occasionally develops. Regardless of its cause, the performance of an exploratory laparotomy would be impossible except on the largest ships. Therefore, palliative measures, as a rule, must be adopted. Among these methods, the inhalation of 100-percent oxygen should be used because, as first pointed out by Fine,[6] it will remove within 24 to 36 hours the greater part of the nitrogen that causes the distention. At the same time, it will keep the patient in better condition and it will combat the circulatory shock that accompanies distention. The best results are obtained if, simultaneously with the administration of the 100-percent oxygen, it is possible to use the Wangensteen or Miller-Abbott suction method of intestinal decompression. The oxygen inhalation apparatus is particularly convenient for the combined types of therapy as the mask is provided with a special hole correctly placed in relation to the nares, through which the suction tube is passed. However, in cases of intestinal obstruction, surgical measures should not be delayed longer than necessary. The improvement in the patient's condition that results from decompression should not lull the surgeon into a false sense of security.

[6] Fine, J., Hermanson, L., and Frehling, S., Further clinical experiences with 95% oxygen for absorption of air from body tissues. Ann. Surg. 107: 1-13, Jan. 1938.

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PNEUMONIA.—In the not too distant past, when morphine, rest, and good nursing were the ultimate in the treatment of pneumonia, it was perhaps advisable to keep aboard ship any patient who had pneumonia provided that the ship had sufficient equipment to render the aforementioned treatment. However, subsequently, with the advent of oxygen therapy by the use of oxygen tents and later, of serum therapy, the advantages of hospital treatment over that obtainable aboard ship became so great that it became practically incumbent on a medical officer to transfer to a hospital any patient who had pneumonia. This often was necessary during inclement weather and over such distances that it was a question whether the rigors of the trip would not outweigh the advantages of better treatment obtainable at the hospital.

Today, with even more efficient oxygen therapy available (by the use of the oxygen inhalation apparatus) than is possible with the oxygen tent, and with the use of sulfanilamide or sulfapyridine and if need be, serum transported to the ship by plane or destroyer, all except the very smallest ships of the Navy would be equipped to treat pneumonia and similar conditions efficiently and effectively. The necessity of immediate transfer of the patient under unfavorable conditions would exist no longer and pending transfer, the patient would have the advantage of excellent treatment. Transfer to a hospital could then be delayed, not only with fairness to the patient but also sometimes, even with greater safety, until favorable circumstances developed.

A severe influenzal type of pneumonia, such as occurred in the epidemic during the World War, would not be nearly the tragedy now that it was at that time. Should such an epidemic occur in a future mobilization, the use of 100 percent oxygen would unquestionably save many. One of us (Boothby) has been informed by the representative of one of the largest concerns that manufacture oxygen and which has distribution points all over the country, that already, complete plans have been developed to meet such a catastrophe. Undoubtedly, all other manufacturers and distributors would cooperate immediately in seeing that the supply of oxygen was unlimited. Even to meet such an emergency in this country would not seriously tax those companies in the manufacture of the oxygen; the greatest difficulty would be in its distribution.

POISON GAS.—The Surgeon General's Report on Statistics of Diseases and Injuries in the U. S. Navy, for the year 1937, lists 25 cases of poisoning that resulted from inhaling various substances, with 2 deaths, both of which were due to carbon monoxide. The substances inhaled included, among others, carbon monoxide, kerosene, naphtha, phosgene, tear gas, and welding fumes. With increased

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experimentation in the use of gases for smoke screens, and so forth, the incidence of poisonings by inhalation very probably will increase, even in time of peace.

One of the most alarming and frequently fatal complications of inhalation of chemical irritants is pulmonary edema. In these cases, the alveoli of the lungs are filled with blood plasma which transudes through the injured alveolar walls and severe anoxemia results. The inhalation of 100 percent oxygen is particularly efficacious in these cases in which the prime indication is to utilize to the fullest extent what alveolar space is left by administering 100 percent oxygen. It is in such cases, in which the available alveolar space is so limited, that the effectiveness of 100 percent oxygen, so easily and efficiently given by means of the B. L. B. oxygen inhalation apparatus, far excels that of 50 to 60 percent oxygen, which is the highest concentration obtainable in the best run oxygen tents, or that of 35 to 50 percent oxygen delivered, as a rule, by the use of a nasal catheter. In some cases of severe pulmonary edema, it is advantageous to administer oxygen under a positive pressure of 3 to 10 cm. of water.

SEASICKNESS.—Although not many sufferers from seasickness enter the naval service and although a good chief boatswain's mate usually "cures" most of the cases that occur, nevertheless, the problem of treating seasickness does exist in the Navy. The aforementioned report of the Surgeon General lists 42 admissions to the sick list for seasickness during the year 1937 and these admissions totaled 1,288 sick days. It may safely be assumed that all of these patients were really sick, and many of them seriously so.

Anyone who has seen a seriously seasick patient, and certainly anyone who has gone through the ordeal, will recognize that he is dealing with a condition of collapse or, in some cases, even shock. We quote from the vivid description by Martin:

> The physical phenomena which accompany the severe stage of seasickness are in many respects identical with the precursors of death. One familiar with the two conditions will easily recognize the resemblance. Mental and physical lethargy, inability to concentrate and an absolute necessity for lying down, are characteristic of both, as well as cold beads of perspiration on forehead and trunk; cold feet and hands, with the chill gradually creeping upward toward the trunk; cold nose; weak thready pulse; greenish yellow color of the face, and sunken eyes. In both instances, the symptoms are indicative of an exhausted autonomic system, with a giving away of the venous vasotone.

This vivid description explains the failure of the thousand and one so-called remedies that have been advocated in the treatment of this malady. As in the treatment of circulatory shock and collapse due to other causes, the inhalation of 100 percent oxygen may improve the seasick patient's condition and aid him to gain his "sea-legs." By relieving the severe anoxemia that exists, the vicious cycle of vomiting,

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dehydration and collapse may be broken. At least, the preliminary experiments justify a more extensive trial to determine its practicability in the Navy.

DROWNING ACCIDENTS.—There were 43 deaths from drowning and 24 admissions to the sick list for nonfatal submersion in the Navy during 1937. When an apparently drowned person is pulled from the water and artificial respiration is begun by the Schaeffer prone-pressure method, two of the prime indications are to clear the throat of any débris and to pull the tongue forward to provide a good airway. It would be ideal if a mask could be fitted to the face so that 100 percent oxygen could be administered. Practically, however, this is usually not advisable due to the danger of obstructing the airway and actually doing more harm than good. Therefore the use of oxygen is not advocated until the airway is clear and there is a good volume of air passing in and out of the lungs either by natural or artificial respiration. The use of oxygen as soon as the airway is clear, together with the application of heat, rapidly will bring the victim out of the secondary danger of shock.

COMPRESSED AIR ILLNESS.—Several investigators have recommended that recompression in conjunction with oxygen inhalation would offer the best results in the treatment of compressed-air illness. Behnke and Shaw showed by experiments on dogs that recompression plus inhalation of varying percentages of oxygen resulted in the same prompt clinical improvement which follows recompression in which only air is breathed, but that in addition it prevented, in large measure, the development of secondary relapses after the release of pressure. This is due to the fact that, although recompression with air reduces the size of nitrogen bubbles or entirely obliterates the bubbles of nitrogen in the tissues, it does not aid in removing the nitrogen present in the tissues at that pressure. Air, which contains 79 percent nitrogen, will saturate the blood to approximately its nitrogen-carrying capacity, and therefore it cannot aid in the removal of the nitrogen. Reduction of the amount of nitrogen in the inspired air by the inhalation of 50 to 100 percent oxygen, depending on the pressure used, will aid in the more rapid removal of nitrogen from the tissues.

When the patient is inhaling pure oxygen, or air with a high concentration of oxygen, the nitrogen in the blood will be quickly washed out or greatly reduced in the lungs and the blood will be able to pick up the nitrogen in the tissues which previously had absorbed nitrogen at higher partial pressures of nitrogen.

For this reason, it is felt that the use of the oxygen inhalation apparatus with which any desired concentration of oxygen up to 100 percent can be administered easily to a patient who has compressed-air illness while undergoing recompression, is a useful refinement in a procedure already employed in the Navy and should result in better

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clinical results and should decrease the danger of relapses. (In the preceding article Behnke and Willmon report that the B. L. B. apparatus has solved the problem of administering oxygen economically in the recompression chamber,—Editor.)

Behnke [7] [8] and others have pointed out that the rate of decompression can be increased with safety if the subject is inhaling oxygen, and thus, the time consumed in routine decompression can be decreased. The B. L. B. apparatus is particularly suitable for extensive use in air locks as it will permit the easy and accurate administration of proper amounts of oxygen to large numbers of men when they come out from working under pressure.

OXYGEN IN AVIATION

For the Navy, the fact that, now, the amount of oxygen needed in aviation can be reduced approximately to one-fourth of that previously required, will quickly result in a change in aerial tactics as employed both by combat and auxiliary ships by always permitting the personnel, at will, to maneuver and fight without the slightest impairment of their mental or physical faculties at any altitude up to 35,000 feet. Unless oxygen is administered, human efficiency begins to decrease measurably at an elevation of 10,700 feet and is decreased to a dangerous degree if altitudes between 16,000 and 20,000 feet are maintained for more than a short time. For efficient fighting, designers of military aircraft can ignore no longer the needs of the human body for oxygen and for protection against cold; they must make adequate provision for oxygen and also must enclose and heat all airplanes, including combat ships. The nation that, whenever desired, always can maneuver its entire air force at high altitudes with the mental faculties of all aboard ship unimpaired by lack of oxygen and with their physical activities unhampered by excessive clothing will have a decided tactical advantage over adversaries not so equipped. Designers now must give thought to the needs of the human mechanism in flying and fighting at high altitudes in order that the flying personnel may meet all the demands forced on it by the recent great advances in mechanical design and equipment of the modern airship.

Recently two of us (Boothby [9] and Lovelace [10]) presented complete reviews of the literature and data which prove conclusively that the

[7] Behnke, A. R., Application of measurements of nitrogen elimination to problem of decompressing divers, U. S. Nav. M. Bull. 35: 219-240, April 1937

[8] Behnke, A. R., and Shaw, L. A., Use of oxygen in treatment of compressed-air illness, U. S. Nav. M. Bull. 35: 61-73, Jan. 1937.

[9] Boothby, W. M., and Lovelace, W. R., II., Oxygen in aviation; necessity for use of oxygen and practical apparatus for its administration to both pilots and passengers, J. Aviation Med. 9: 172-198, Dec. 1938.

[10] Berle, C. K. and Lovelace, W. R., II., Oxygen therapy and its practical use with troops on active service, Washington, D. C., Tr. Tenth Internat. Congress of Mil. Med. and Pharmacy, 1: 321-358, 1939.

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administration of oxygen should be provided for in commercial flying for elevations in excess of 10,700 feet. The reader is referred to these papers for this information. In military aviation, other considerations, at times, may be more important than safety; under such circumstances, the administration of oxygen need not be started until altitudes slightly higher than 10,700 feet are reached.

AMOUNT OF OXYGEN REQUIRED AT DIFFERENT ELEVATIONS

One of the most important factors which will influence the extent to which oxygen will be used in aviation is the amount which must be supplied to each person per minute. The weight of the containers for oxygen makes it essential that the amount of oxygen used per minute be reduced to the minimum that will maintain the partial pressure of oxygen in the lungs equal to that which normally exists at sea level.

Our apparatus, therefore, has been designed to conserve oxygen to the utmost. In an apparatus with a constant flow, between two-thirds and four-fifths will be lost during the expiratory phase of the respiratory cycle, depending on the person's respiratory curve. We have prevented this loss by the use of the reservoir-rebreathing bag which we have described previously in detail. Not only does this reservoir-rebreathing bag conserve all the oxygen that flows from the tank during the expiratory and resting phase of the respiratory cycle, but also it collects for use on the next inspiration the first part of the previous expiration which comes largely from the "dead space" which already has been enriched with oxygen and at the same time contains comparatively little carbon dioxide.

We realize that a reservoir-rebreathing bag is an inconvenience; however, there is no way to avoid this except by using at least four times as much oxygen by carrying the extra amount of weight in oxygen tanks which will either decrease correspondingly the gasoline or ammunition carried, or the radius of flight.

Undesirable movement or swaying of the bag, especially when the wearer leans forward, may be prevented by attaching a small elastic strap or rubber band to the connecting-regulating device and by fastening this in turn to the wearer's coat by means of a snap or clasp. Occasionally, it may be found desirable to use a similar rubber band to hold the lower end of the reservoir-rebreathing bag in place.

Table 1 gives the rate of flow of oxygen in liters per minute measured at standard temperature and pressure, dry, as recommended by two of us (Boothby and Lovelace) for use with the B. L. B. oxygen-inhalation apparatus in order to maintain the pressure of oxygen in the lungs the same as at sea level. For comparison there are given corresponding rates of flow at present commonly used by and generally recommended for other types of apparatus. It should be noted that

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the amount recommended for our apparatus is approximately one-fourth the amount needed when other forms of apparatus are used.

TABLE 1.—*Oxygen required at various elevations*

Elevation		Oxygen used by B. L. B. apparatus, liters per min. STPD	Oxygen used by other types of apparatus, liters per min. STPD
Thousands of feet	Kilometers		
0	0	0	0
5	1.5	0.3	1.0
10	3.1	0.5	1.9
15	4.6	0.7	2.7
20	6.1	1.0	3.3
25	7.6	1.3	4.8
30	9.1	1.7	6.0
35	10.7	2.1	8.2
40	12.2	----------	10.0

When breathing pure oxygen at an altitude of 40,000 feet the partial pressure of oxygen in the alveoli will be approximately 54 mm. of mercury (141 minus 47 plus 40). The hemoglobin of the arterial blood will be less than 80 percent saturated; the subject will be very cyanotic and his mental and physical ability greatly impaired. An elevation of 35,000 feet should be considered the upper limit of safety even when breathing pure oxygen.

ACCESSORY EQUIPMENT FOR AVIATION

After the B. L. B. inhalation apparatus, described earlier in this paper, was developed and found physiologically efficient, it became necessary to obtain reducing valves and flowmeters which would measure and deliver accurately the small rates of flow used by each individual. A search of the market revealed no suitable apparatus, because similar devices previously used in aviation had been built and designed for use with many times the amount of oxygen required by the B. L. B. apparatus at all altitudes. In fact, the knowledge possessed by the commercial firms about how reducing valves and flowmeters functioned at high altitudes was very limited. So we found it necessary to leave our own field of investigation to seek cooperation with the manufacturer of this type of equipment.

Two of us (Boothby and Lovelace) in cooperation with the Heidbrink Division of the Ohio Chemical & Manufacturing Co. and with the aid of Mr. Karl O. Larson, Chief Engineer of the Northwest Airways, have finally evolved a light, efficient, and accurate apparatus which we will describe only very briefly.

Because of the smaller amounts of oxygen required per person per minute when using the B. L. B. apparatus, it is of vital importance that the flow of oxygen be accurately controlled and that flowmeters be of the dry-float type. This type of flowmeter, often called the kinetic type, will not register unless the appropriate amount of oxygen

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is actually flowing through the meter to the mask assembly; it is, therefore, an added factor of safety.

Oxygen reducing valves and flowmeters are greatly affected by the decreased barometric pressure at various altitudes, and for this reason all flowmeters must be calibrated carefully under actual conditions of low pressure. The kinetic type of flowmeters are calibrated by placing them in a bell jar, which is then evacuated to the desired simulated altitude. The oxygen is then turned on and each Hi-Co flowmeter (the flowmeter constructed for use at high altitudes which was mentioned previously) is calibrated against a master flowmeter which, previously, was calibrated carefully by one of us (Lovelace) in our laboratory by determining the weight of oxygen delivered in a known time under identical conditions. The rate of flow is expressed in liters per minute at standard temperature and pressure, dry, recommended for the various altitudes when the B. L. B. inhalation apparatus is used.

Illustrated in figure 10 is the standard unit with two masks, one for the pilot and one for the co-pilot in transport ships, or one for the pilot and one for the passenger in smaller two-place ships. Cylinder A together with the high-pressure regulator F can be placed in the tail of the ship or in such a place as will be most convenient for installation. The low-pressure regulator G and the flowmeter I should be situated in the control cabin, the flowmeter on the instrument panel and the low-pressure regulator within easy reach of the pilot for manipulation.

To conserve oxygen and at the same time to be certain that there is an adequate supply of oxygen, the pilot should adjust the rate of flow at each 5,000 feet level unless ascending very rapidly, in which case he can make the original setting to approximate his expected maximal elevation; on approaching this elevation the rate of flow should be immediately adjusted with accuracy. No automatic device activated by the barometric pressure has been devised as yet which will produce anywhere near the proper variation in rate of flow that will allow the oxygen pressure in the lungs to be maintained the same as at sea level regardless of the elevation.

As aforementioned, the flowmeter is of the kinetic type and registers only when oxygen is actually flowing. It is calibrated in thousands of feet of altitude, and in liters by weight of oxygen at standard temperature, and the flowmeter is always open to the pilot's mask.

We suggest flexible aluminum tubing "B" (fig. 10), with an outside diameter of ⅜ inch and a wall 1/32-inch thick between the pressure regulators "F" and "G"; the tubing "H" is of heavy walled non-kinking rubber. All oxygen flows to the masks are controlled by regulator "G", of which part 1 is a knurled thumbscrew for controlling the amount of oxygen passing to the mask, part 2 is a locking

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wheel to prevent change of flow due to vibration and part 3 is the outlet petcock to the masks of the co-pilot and passengers.

In larger installations, in order to supply oxygen to passengers or crew, an aluminum pipe line is connected to the second-stage reducing valve instead of to the petcock (3) and is extended around both sides of the cabin to the passengers' seats. At each seat there is installed inside the lining of the ship either a base block with a "plug-in" connection or a base block with a petcock. Both "plug-in" and petcock are equipped with limit ports which insure delivery of the same volume of oxygen to all passengers and co-pilot as that received by the pilot and it is registered on the flowmeter. All these limit ports must have exactly the same diameter and the same length.

By having one or more special outlets with a needle valve and specially calibrated flowmeter, any desired concentration of oxygen could be administered to passengers who needed it, such as patients who have heart disease, air sickness, and so forth. Such special outlets should be installed in airplane ambulances so that, during transportation, patients who are in shock or who for other reasons may need high concentrations of oxygen may have it available.

Each pilot and all personnel who fly regularly should be provided with their own equipment so that they can have the retaining straps properly adjusted in length once and for all. Each member of such personnel should be made responsible for the preservation and cleanliness of his own outfit. After each time that the apparatus is used, it must be disassembled and thoroughly washed with soap and water, rinsed thoroughly with running water and then hung up to drain. Antiseptics should not be used. Outfits used by more than one person must be boiled after washing to prevent the spread of respiratory infections.

The B. L. B. oxygen inhalation apparatus already has proved to be practicable in commercial airplanes and actually has been used in airplanes at 31,000 feet and in a low-pressure chamber up to pressures corresponding to 35,000 feet.

However, for actual fighting, the apparatus should be provided with extra retaining straps to prevent dislodgement of the apparatus under the excitement of combat. Likewise, some additional protection should be provided around the reservoir-rebreathing bag so that the fighters' activities could not displace the bag or apparatus. If used in open ships, electric heating coils must be incorporated in the connecting-regulating device; under these conditions a pouch could be provided on the front of the aviator's suit to surround and protect the rebreathing bag but so made that free expansion and contraction of the reservoir-rebreathing bag is not hampered. All these modifications, however, must be made to conform to the type of suit used by the aviator and to the position of the parachute straps, with con-

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sideration of the specific duties assigned to each individual. Such modifications will have to be developed in cooperation with the flight commanders to meet the needs of the different types of fighting ships.

DANGER OF RAPID ASCENT.—The rapid rate of ascent now possible in certain types of military craft brings up a new danger to aviation which did not exist previously, namely, the danger of too rapid decompression, with formation of the bubbles of nitrogen in the blood stream and tissues. The Navy already is well acquainted with the dangers of too rapid decompression in divers. As yet, timetables have not been worked out to determine the rate at which extreme degrees of elevation may be attained in aviation with safety. We hope to be able to institute such experiments shortly in our low-pressure chamber in which it is possible to decompress with great rapidity. The program contemplates also the study of the effect of washing out the nitrogen from the blood and tissues by the inhalation of 100 percent oxygen immediately before ascent is started.

Until such experimental data are available, the best that can be done is not to exceed the rate of decompression recommended for deep-sea diving in coming up from a total pressure of four atmospheres which would correspond to the dangers of ascent from sea level to one-quarter of an atmosphere. Pains in joints and bones during ascent should be considered as warning signs of impending danger.

A common practice in decompression from diving is to come up at a rapid rate to a level at which about one-half the original maximal pressure exists, and then to decrease the rate of ascent according to a definite timetable. In the case of divers, however, who have overstayed their time at the bottom, it is usually not safe to proceed rapidly to the level that corresponds with one-half the original pressure or to proceed thereafter as rapidly as is customary. This slower ascent is necessary because of the greater saturation of the tissues with nitrogen. An aviator will be completely saturated with nitrogen on leaving the ground; therefore, in the very rapidly ascending planes the rate of ascent should be decreased before an elevation of 18,000 feet, or one-half an atmosphere, is reached—probably at 15,000 feet. From this level up to one-fourth of an atmosphere, or about 33,500 feet, somewhere between 40 to 60 minutes probably will be necessary. Preliminary removal of the nitrogen in the tissues by the use of 100 percent oxygen would permit a more rapid ascent.

SUMMARY

In the Navy, the conditions which chiefly will be benefited and often prevented by early inhalation of 100 percent oxygen are: Surgical collapse or shock; shock following traumatic or gunshot wounds; acute abdominal distention; gas gangrene; tetanus, pneumonia and profuse pulmonary edema.

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Because of the compactness and simplicity of operation of the B. L. B. inhalation apparatus, efficient oxygen therapy will be possible at sea even on the smallest ships of the Navy.

In aviation, the use of this apparatus will be advantageous because approximately one-fourth of the amount of oxygen previously required will maintain a pressure of oxygen in the lungs equivalent to that at sea level up to an altitude of 35,000 feet.

DEEP-SEA DIVING COURSE FOR OFFICERS

By Lieutenant (Jr. Gr.) Joseph J. Blanch, Medical Corps, United States Navy

An embryo doctor happily engaged in the business of active general medical practice in a splendid naval hospital is ordered to attend a course of instruction in diving. He rightfully wonders at the significance of such orders and questions the practicability and possible relationship between naval medicine and the making of him a qualified diver. The answer to this question given by a junior medical officer at the completion of a course fitting him for this function constitutes the topic of the present discussion.

It was my pleasure as a junior medical officer in the naval service a short period of time to be in attendance upon a course of instruction at the Deep Sea Diving School, Washington, D. C. The class comprising five officers of the line and four junior medical officers was the first group of officers to attend a course devoted primarily to diving. It is hoped that this written account will verily represent my personal impressions and in some measure indicate what, of practical value, has been gained in this period of 11 weeks.

Submarine medicine, as including the medical problems arising from the unnatural existence of men in conditions brought about by duty in submarines and the specialized and perplexing situations that accrue from men's pervading the depths of water in deep-sea diving, stands off as a real medical entity. It involves general medical practice as applied to men in probably the most disease-free period of life plus an influence of unusual physical environment having some very definite physiologic and pathologic responses in the form of correspondingly unusual symptoms.

Of necessity the problems of submarine and diving operations have a conspicuously medical flavor. A group of divers comprising the enlisted personnel—boatswain's mates, torpedomen, in a casual conversation about their work might be heard speaking glibly of air embolism, the affinity of certain tissues for nitrogen and similar expressions long since the treasure of the medical profession.

It easily becomes apparent that this important phase of national defense has drawn upon the resources of medicine for its development

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and progress. Divers and submarine personnel, evidently, have been found to require an acquaintance, at least, with human physiology to insure their safety and to carry out orders rationally in this work. But why make a doctor a diver?

If it is intended that a certain percentage of naval medical officers become familiar with medicine as applied to diving and submarine hazards, their treatment and prevention, could they not be given systematic lecture courses in the physiology, pathology and treatment of bends, carbon dioxide poisoning, and the like? They could indeed. Then they would be "in on the know," but unfortunately they would not necessarily be "in on the do." As a matter of fact there is more to it than this. It takes very little imaginative effort to become aware that innumerable things of a medical nature can arise that call for originality and resourcefulness that do not partake of the nature of compressed-air illness alone. It is indeed conceivable that, during a tour of duty in association with diving operations, not a single case of the latter might be seen. In so many words, it is quite apparent that the approach to familiarizing medical officers with diving and submarine health hazards, their prevention and treatment has been properly made.

The officers' diving course has followed, in general, along the same lines, that of the enlisted men who are to become second- and first-class divers, differing from theirs in duration and in intensity but simulating it enough to establish a real appreciation of what deep sea diving consists.

The doctors subjected their "lily-white" hands to the indignity of shearing rivet-heads with hammer and chisel and their "hyper-sensitive fingers" were put to the task of securing nuts to bolts without the aid of vision in the blackness of the river bed as they squatted in knee-deep mud. They experienced the intoxicating depth of 300 feet or its equivalent in pounds of pressure per square inch, where they were required to perform the typical diver's task of making a submarine fitting secure. The adeptness with which they could burn a half inch iron plate by hydrogen torch under water soon became a matter of pride. In other words we were led along the inside track of deep-sea diving and taught the salient features and the typical functions of the business of diving. We were enabled to see diving from the diver's point of view.

The experience of being subjected to a pressure the equivalent of a 300 or even 250 foot depth of water, is one not readily to be forgotten. As a final test of physical qualification for actual diving, each member of the class was exposed to this pressure in the diving tank. The student donned full diving gear and descended the ladder into approximately 8 feet of water. The ladder was withdrawn, the hatch closed and secured, and air pressure was turned on until the gage registered

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100 feet or 44 pounds pressure per square inch. At this pressure the diver is well aware of his depth by the degree to which he finds it necessary to forcefully expire while he keeps his mouth closed and his nose obstructed to relieve the slightly painful pressure on his eardrums, the amount of additional air he has to admit to his diving suit in balancing the sense of pressure on his body, and by the slightly lessened muscular coordination and somewhat diminished ability for sustained mental concentration. On another day the pressure was increased to a 150-foot equivalent, then on another to 200 and 250—when finally the day arrives when he qualifies at the 300-foot depth or 133 pounds per square inch of body surface.

As this graduated increase proceeds an instructor, a master diver, steady, far-seeing and wise from almost a lifetime of diving, together with the commanding officer of the school acutely sensitive to every ominous sign in a diver's attitude, that might arise, study the subject with incredible attentiveness through two of the several eye ports in the tank, for this purpose, while one hand is trained on the pressure release valve. Actually, the diver is safer than the average pedestrian in a city during the noon hour. When the depth is reached, the diver is asked how he feels and over the telephone comes a reply, favorable, but which sounds like the quacking of a duck much reduced in volume and articulated into words, and he is told to "go to work", where he sets about the task of the simulated submarine fitting. The task completed, he is told to stand by to come up and the pressure is released with certain depth stops according to a standard decompression table.

At 300 feet the strange experience is magnified. There has been much more inflating of his Eustachian tubes, the air supply has been increased until it now has the sound of a nearly deafening high-pitched hum, vision is blurred somewhat, activity definitely less accurate and even incoordinate, and the prescribed task is now an obsessive compulsion from which the diver can hardly deviate lest he should completely lose sight of his original intention. This mental state is a physiologic condition at present ascribed to the anesthetic effect of nitrogen at high pressures somewhat akin to that of nitrous oxide at atmospheric pressure. At this point some individuals more susceptible than others momentarily lose consciousness, which is quickly restored by a slight release of pressure. This is some of what a diver experiences at great depths of sea water.

Fortunately for this class of officers, the experimental unit made available the required apparatus for use of helium and oxygen mixture in diving. Each of us was given a 240-foot dive using this gas mixture and we were impressed by the remarkable contrast, there being no mental disturbance produced whatsoever—the first time in the history of deep diving that this factor has been eliminated.

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Actual diving has its distinctive features. The diver descends a ladder under a burden of 200 pounds of diving gear and a tool bag on one shoulder. He takes a firm grasp with one hand and both legs on the descending line, the other hand thoughtfully adjusting his life-sustaining air supply. His head is within a confining metal helmet which resounds to a brassy scream of ingressing air. He busies himself at equalizing air pressure of the nasopharynx with that of the middle ear as he is lowered into a deep grave-like abyss. At this point he hardly has time to suffer from claustrophobia and besides there is a definite task to perform and he must also maintain communication with the other diver and with the tender. Admittedly this soon becomes a matter of course and as routine as driving a car, but other complicating factors are always imminent. The life line and air hose become fouled about the submarine accessories very readily and well meant efforts for relief, at this time, may quickly kink the air hose—an unpleasant consideration, to be sure, but entirely possible and not at all improbable. When the prescribed task is completed the student is directed to ascend his 65–70 feet of descending line, then to hurriedly descend and again ascend so as to experience in some measure the fatigue that is so frequently experienced by a diver when working under more unusual and less favorable conditions.

The foregoing description applies fairly well to one of the dives in the Chesapeake Bay, taken at the climax of the course when a submarine was provided, submerging each day off Piney Point, Md., and dives were made from the surface immediately above it. All of this assists our imaginations materially and brings ours nearer the diver's viewpoint.

It becomes clearly apparent that without this direct experience the doctor is in no position to anticipate the probable nature of casualties that can occur to a diver. The squeeze, for example, consequent upon falling unexpectedly to a greater depth of water, one of the most appalling accidents in diving, might vary from transient unconsciousness from a sudden slight increase in pressure applied to the man's body to a weird annihilation as his body is molded into his helmet, which is the most pressure-resistant space, depending upon the extent of his fall and the proportionate additional pressure. The doctor who has nearly had a misstep off the deck of a submerged submarine, for instance, can appreciate this possibility while otherwise he would be apt to forget that such accidents occur.

A diver who has sustained a dislocated shoulder with all its attendant pain might be judged as afflicted with bends but the diver-doctor can visualize occasions for this kind of mishap and institute treatment accordingly. In short, he has now a new perspective based upon personal experience to influence his therapeutic regime when divers become his patients.

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Instances throughout the diving instruction period which make for resourcefulness on the part of the physician and so equip him for attendance to the physical ills peculiar to divers are legion and the points of a technical nature that he learns about diving are numerous, but suffice it is to say that to gain the attributes herein referred to a course in actual diving is necessary.

A doctor, lacking this experience, on sea duty aboard a submarine tender or on duty at a place where diving operations are in progress, is apt to be nothing short of bored, except at a time of real emergency; but after having, himself, qualified at diving he has reason to be intensely interested and is no doubt more alert should his professional services come to be needed.

Occasionally throughout this period of training, we received didactic lectures from members of the experimental diving unit, authorities on their subjects. These were very useful and stimulating. They concerned the subjects of present-day knowledge as to the nature of compressed-air illness and its treatment, the recently developed use of helium and oxygen mixtures for diving and a discussion of submarine medicine. The talks were of semitechnical nature and matters well worth considering from the medical standpoint. We availed ourselves of the opportunity of reading the written material on the Momsen escape lung and its development, studied its mechanism directly, following which we were enabled to utilize its principle by simulating an escape in the diving tank. Touring the *S-22*, it was clearly understandable how escapes could be made through the two escape locks, the skirted hatches and even the topmost pair of torpedo tubes.

As the diving course was still in progress, the submarine *Squalus* became disabled at a depth of 240 feet. Having become somewhat familiar with the nature of such circumstances, it was now possible to visualize the probable method of attacking the salvage problem on the part of the diving crew and to anticipate the medical problems that might arise. This merely indicates that the course we were completing had, in truth, accomplished one thing at least. It had enabled us to think in terms of diving and along the lines of submarine operations.

The importance of selecting the proper type of men for duty with submarines and for diving has been impressive. Moreover, the medical officer has much to do with this. These qualifications are set down clearly in the C. & R. manual.

A number of our instructors were master divers. Daily informal discussion with them about diving, their personal experiences and reactions and their experience with students in diving provided us with an insight into the need for even temperament bordering on the phlegmatic personality coupled with clear-headedness. Some of

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the physical qualifications, too, have become apparent. Hypersusceptibility to head colds might prohibit a man's diving for considerable periods of time due to an inability to equalize pressure on the two sides of his tympanic membrane in making a descent to high pressure. Occlusion of the ostia of the paranasal sinuses gives rise to intense localized pain in a man exposed to pressure. The physical fitness of an athlete at the height of his training is none too good for a diver in his routine work. If he is fat he is more subject to bends.

The meticulous attention to detail in supervising a diving operation is striking. The alertness and all inclusive attention of the commanding officer of the diving school from beginning to end of a day's session of instruction, impressive at first, became recognized as a true necessity later on in the course.

I have observed the importance of keeping up the diver's morale and men of experience have testified to this. When he has blundered, it appears to require an effort at reasoning with him and explicitly stating what constituted his error or if it is evident that he is aware of his mistake, to say nothing rather than administer severe correction which is so provocative of emotionalism. A diver needs all his wits about him. There is clearly no place for emotion in diving and submarine duty, though firmness need not be neglected.

The doctors were required to acquaint themselves with the use of the recompression chamber and to demonstrate their ability to operate it independently, as this constitutes the specific treatment for compressed-air illness. It might be mentioned, too, that a number of publications and books were read to the point of satisfying ourselves with the nature of compressed-air illness and other disabilities incident to diving insofar as literature on these subjects is at present available. A very instructive outline of treatment for compressed-air illness has been provided in the closing section of the experimental unit's recent report.

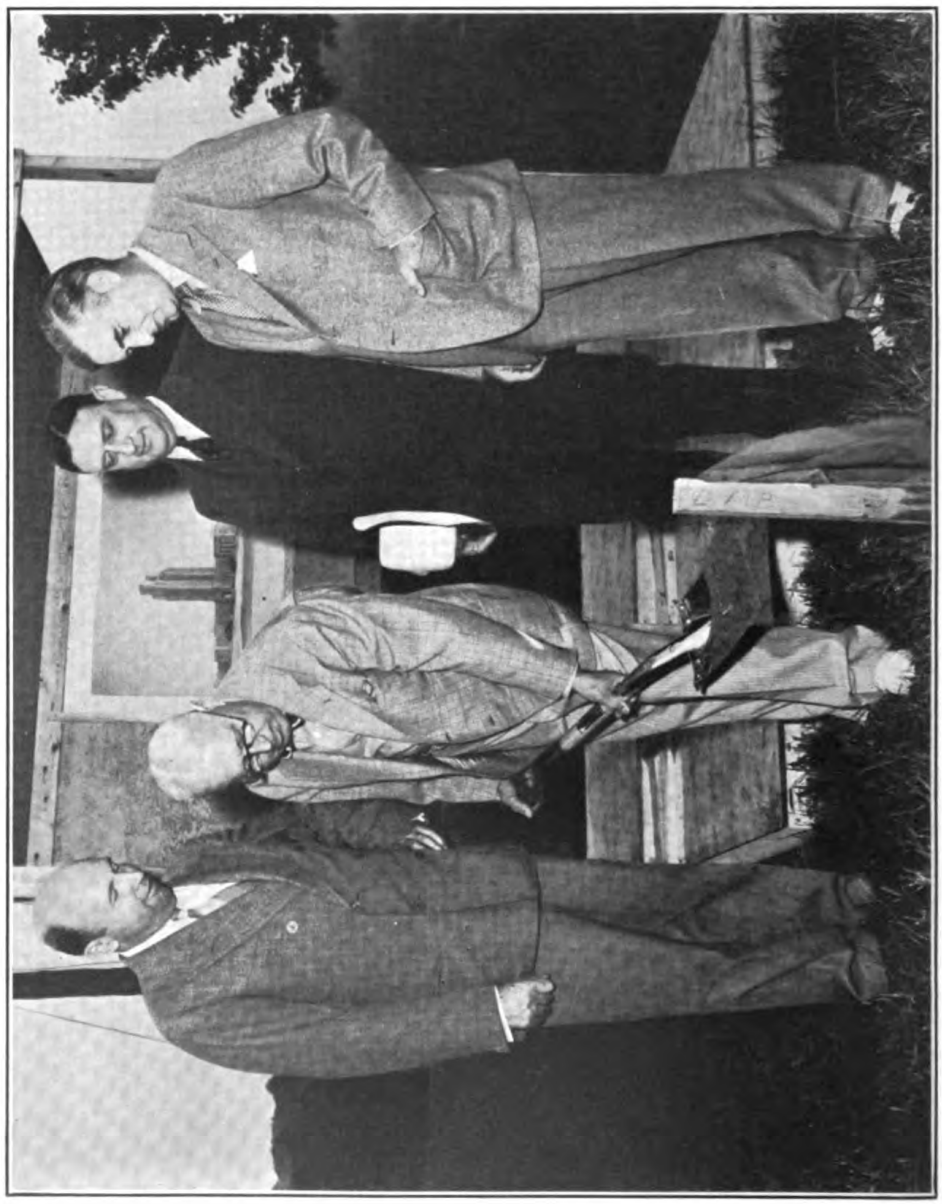
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BREAKING GROUND FOR NAVAL MEDICAL CENTER.
Left to right: Admiral McIntire, Admiral Rossiter, Admiral Morsell, Secretary Edison.

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NOTES AND COMMENTS

NAVAL MEDICAL CENTER

Exercises on June 29, 1939, marked the beginning of construction of the new Naval Medical Center, Washington, D. C., at the site near Bethesda, Md. Rear Admiral Ben Moreell, Chief of the Bureau of Yards and Docks of the Navy Department, opened the ceremonies with the statement that it was the inauguration of what we hope and expect will be the finest establishment in the world for the teaching and practice of military medicine. The project is one of cooperation. The President has taken an active part in the initiation of the Center, and the Secretary of the Navy, the Assistant Secretary, and the Chief of Naval Operations have all given their personal support and encouragement.

The Assistant Secretary of the Navy, Mr. Charles Edison, spoke with approbation of the beautiful rural setting, and its special suitability for the Naval Medical Center. Rear Admiral Ross T. McIntire, Surgeon General of the Navy, said that, for the first time in planning naval hospitals, we are looking ahead to the needs of years to come. He predicted that the new center would result in great good in the field of military medicine and hygiene, and would also benefit aviation medicine.

Rear Admiral Perceval S. Rossiter, the former Surgeon General of the Navy, under whose regime the project was inaugurated, then broke the ground with a shiny new spade and very creditable technic. He stated that the ceremony was the materialization of a hope in the hearts and minds of the members of the Medical Department of the Navy for a long time.

The contract for the first portion of the foundations has been let to John McShain, Inc., who built the Philadelphia Naval Hospital. Construction is now under way.

NEED FOR SPECIALISTS IN THE MEDICAL CORPS OF THE NAVY

The Bureau of Medicine and Surgery particularly desires medical officers of the Navy to become familiar with the Bureau's Circular Letter "M" in Appendix D of the new Manual of the Medical Department. This circular letter outlines the procedure to be followed by medical officers who desire to become specialists in any particular branch of Medical Department activities.

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At the present time there is an acute shortage of qualified medical officers in the following specialties:

Aviation medicine.
Deep-sea diving and submarine medicine.
Psychiatry.
Laboratory.
Roentgenology.

The rapidly expanding naval program and the increasing demand for specialists in these branches make it desirable to place several medical officers under instruction immediately. Commanding officers of naval hospitals, senior medical officers of Navy and Marine Corps activities, and senior officers of the Medical Corps are urged to cooperate with the Bureau in bringing this information to the attention of likely candidates, and are requested to render every assistance in furnishing information and advice in this regard.

Lieutenants and lieutenants (j. g.) of the Medical Corps are particularly desired for training in aviation medicine and in deep-sea diving and submarine medicine. Medical officers of all ranks from lieutenant commander to lieutenant (j. g.), inclusive, are eligible for training in the other specialties mentioned. The current general policy of assignment to training of applicants who have been accepted is as follows:

AVIATION MEDICINE, to the Army Base at Randolph Field, Tex., for a 4-month course of instruction, upon the successful completion of which they will be assigned to the Naval Air Station, Pensacola, Fla., for practical instruction for 3 months. Their assignments then are determined by the needs of the service which will be in connection with their specialty at air stations, both in and beyond the continental limits and on aircraft carriers. It is anticipated several very attractive billets for flight surgeons will be available in the near future.

DEEP-SEA DIVING and SUBMARINE MEDICINE, to a 2 months' course of instruction at the Experimental Diving Unit, Navy Yard, Washington, D. C., and upon successful completion of this training to the submarine base, New London, Conn., for an advanced course of 4 months' duration, after which they will be detailed to submarine tenders and submarine bases.

PSYCHIATRY, to St. Elizabeths Hospital, Anacostia, D. C., for several months' training and those who demonstrate a good basic knowledge of this specialty to an advanced course at the University of Pennsylvania of 8 months' duration. The services of qualified psychiatrists can be utilized at the larger naval hospitals, hospital ships, and at the naval training stations during the periods of rapid increase of enlistments. In the smaller hospitals psychiatrists are also assigned medical wards.

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LABORATORY, to a course of instruction at the Naval Medical School, during 8 months to 1 year.

ROENTGENOLOGY, to a course of instruction at the naval hospital, San Diego, Calif., for 1 year. Candidates who have had previous experience in this specialty and who demonstrate qualifications are assigned to Cornell Medical Center, New York City, or to Cook County Graduate School of Medicine, Chicago, Ill., for an advanced course of 4 months.

It is the policy of the Bureau to keep filled at all times all medical-officer sea billets, and billets in the important shore establishments. However, the forwarding, without delay, of requests for special instruction is encouraged. By this means the Bureau will be in a position to make arrangements for this training if reliefs are required.

THE HOSPITAL CORPS

The attention of all commanding officers of naval hospitals and senior medical officers of all Navy and Marine Corps activities is invited to the present personnel situation of the Hospital Corps.

The allowance of the Hospital Corps for the fiscal year 1940, approved by the Bureau of Navigation, and the number on board as of July 1 is indicated by the following table:

	CPhM	PhM1c	PhM2c	PhM3c	HA1c	HA2c	Total
Allowed (1940)	619	678	977	1,205	652	506	4,637
On Board (July 1, 1939)	577	634	918	1,074	637	427	4,267
Shortage	−42	−44	−59	−131	−15	−79	−370

The following promotions will be effective as of August 16, 1939:

CPhM	PhM1c	PhM2c	PhM3c	HA1c
11	68	59	151	168

After August 16 there will be no pharmacist's mates, first-class, on the promotion list for chief pharmacist's mate, the list having been exhausted. This means that there will be no promotions to chief pharmacist's mate until February 1940, at which time it is estimated there will be an actual shortage of over 100 chief pharmacist's mates. This shortage will necessitate a temporary reduction in number of chief pharmacist's mates assigned to all shore stations. To a less degree this reduction will also apply to those in the fleet. In view of this fact, the Bureau will appreciate the cooperation of all Medical Department personnel in meeting the future emergency.

In so far as is practicable, every effort will be made to supply numerical reliefs of pharmacist's mates, first-class, for chief pharmacist's mates until such time as a sufficient number of pharmacist's mates, first-class, qualify for promotion.

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The Bureau endeavors in its nominations of pharmacist's mates, first-class, and chief pharmacist's mates (acting appointment) to afford every hospital corpsman an opportunity to obtain the sea duty required for advancement in rating. This policy will be followed to the extent possible, but it is believed certain pharmacist's mates, first-class, may of necessity be retained on shore duty until they are replaced by men returning from sea assignments.

Generally, men who are promoted to chief pharmacist's mate (acting appointment) are nominated for sea duty in order that they may qualify as permanent appointment chiefs, and replace pharmacist's mates, first-class, or chief pharmacist's mates who have attained their necessary actual sea duty. The normal tour of sea duty for all enlisted men is 3 years, but the exigencies of the service frequently necessitate the shortening of the sea cruise.

Under the present arrangements with the Bureau of Navigation, 70 seamen, second-class, are sent to the Hospital Corps schools each month, and, in addition thereto, the Bureau is authorized to nominate 10 enlisted men from the fleet for these monthly classes. At the present time there are on file only 22 applications from enlisted men throughout the service who desire training at the Hospital Corps schools. It is imperative that Medical Department personnel actively interest themselves in obtaining good men for the Hospital Corps. The requirements are a high-school education or its equivalent, and in certain cases of outstanding men, the Bureau will approve 2 years of high-school education, provided these men show interest in Hospital Corps activities and otherwise appear likely candidates.

Applications for the course of instruction at the Hospital Corps schools will be filed in order of their receipt in the Bureau and 10 men will be transferred to this instruction each month. It is believed that medical and dental officers, and other members of the Medical Department, are in positions to interest likely candidates and to assist and encourage the better type to apply for instruction at the Hospital Corps schools.

Medical Department personnel who are assigned to examining boards for the promotion of hospital corpsmen are urged to exercise great care in carrying out the instructions regarding examinations. By failing to comply with the Bureau of Navigation instructions in this regard, a few months ago the examinations of all lower rated hospital corpsmen in one district had to be thrown out, and in the examination recently held another district made a similar error with the result that the examinations of all lower rated hospital corpsmen in that district had to be thrown out. This is obviously unfair to the men affected and does not tend to increase the morale of the Hospital Corps. This particularly applies to mark 1 on Form–N. Nav. 524 covering "a" to "n" subjects. A mark of less than 2.5 in any question

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"a" to "n" fails the candidate. Examining boards should ask a sufficient number of questions in each subject so that the candidate will at least have a fair test. If only one question in each subject "a" to "n" is asked and the candidate fails to answer it correctly, he fails the entire examination. The Bureau is of the opinion that at least 4 to 6 questions in each subject from "a" to "n" should constitute the examination.

Practically 200 hospital corpsmen are at present undergoing instruction in the various Medical Department specialties and it is the policy of the Bureau to maintain this number under instruction continuously. The various specialties, location where instruction is given, and the duration of the courses are outlined in Circular Letter "M" in the appendix of the new Manual of the Medical Department.

It has been the experience of this Bureau that hospital corpsmen who transfer to the Fleet Reserve and desire positions either in the Government services or in civil life, are much more likely to obtain these positions if they hold a certificate of qualification in any of the Medical Department specialties.

The urgent need at this time is for laboratory, x-ray, dental and aviation medicine technicians. With the cooperation of all Medical Department personnel, it is believed these requirements will be met in the near future and the Hospital Corps maintained at 100 percent efficiency.

REVISION OF BUREAU PUBLICATIONS

Annual changes for the Bureau's manual and circular letters will be issued to the service to take effect July 1. Errata and contradictory instructions occur in the manual. The index, particularly, passed through four revisions and time did not permit a final accurate check of references. Information as to errata or other suggested changes will be appreciated in preparation of the forthcoming changes for the manual and revision of circular letters. These suggestions should reach the Bureau prior to April 1 each year for inclusion in the current revision.

The Bureau has adapted a policy of reviewing all forms prior to reprint. All activities are requested to make a careful survey of the forms they use and to forward to the Bureau any suggestions for revising or deleting forms for the best interest of the Service.

This Bulletin is published to disseminate timely information to the Service. The budgetary allowance for this publication has been cut $1,000 for the current fiscal year. This means fewer pages, even greater economy in use of illustrations, and no reprints to authors. Suggestions for improvement of this publication are also solicited.

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BOOK NOTICES

Publishers submitting books for review are requested to address them as follows:

The Editor,
UNITED STATES NAVAL MEDICAL BULLETIN,
Bureau of Medicine and Surgery, Navy Department,
Washington, D. C.

(For review)

A TEXTBOOK OF SURGERY BY AMERICAN AUTHORS. Edited by *Frederick Christopher, B. S., M. D., F. A. C. S., Associate Professor of Surgery at Northwestern University Medical School; Chief Surgeon, Evanston (Illinois) Hospital.* Second Edition, Revised. Pp. 1,651. Ill. 1381. W. B. Saunders Company, Philadelphia. 1939. Price $10.

This is a collection of monographs by 188 leaders in surgery. The muster roll reads like the very cream of the profession. No one can question its authority. The bookmaking is up to the Saunders standard.

This is a most valuable book.

TEXTBOOK OF GENERAL SURGERY. By *Warren H. Cole, M. D., F. A. C. S., Professor of Surgery, University of Illinois College of Medicine, formerly Associate Professor of Surgery, Washington University School of Medicine, Saint Louis,* and *Robert Elman, M. D., Associate Professor of Surgery, Washington University School of Medicine.* Second Edition. Pp. 994. Ill. 559. D. Appleton-Century Company, Inc., New York. 1939. Price, $8.

Another high-grade textbook by well-known and competent authors. It is well written and complete, also a well-made book. One useful feature is the illustration of common faults in operating-room technic. The chapter on surgical diseases of the chest, by Evarts A. Graham, is of unusual excellence.

The book should prove an admirable guide for students and beginners in surgery.

SURGICAL ANATOMY. By *C. Latimer Callander, A. B., M. D., F. A. C. S., Associate Clinical Professor of Surgery and Topographic Anatomy, University of California Medical School; Member of Founders' Group of the American Board of Surgery, etc.* With a Foreword by *Dean Lewis, M. D., Sc. D., LL. D., F. A. C. S.* Second Edition. 1939. Pp. 813. Ill. 819. W. B. Saunders Co., Philadelphia. Price, $10.

"Discoveries are no longer to be made in gross anatomy, and it has become, as far as research is concerned, a more or less sterile field."

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So states the foreword, and there can be little doubt of its truth. Thus, the difference between one book on anatomy and another becomes largely a matter of presentation. In this volume the practical application of anatomy to the surgery of each part of the body is strongly emphasized.

Close study shows little to be criticised. It is difficult to understand the value of a very obscure illustration of trachoma of the lower lid in a work on surgical anatomy. The statement that "A ranula is a retention cyst of the submaxillary or sublingual ducts" indicates a very superficial view of an extremely complex subject, concerning which there is wide variance in opinion. But the good qualities of the book far outshine its few defects. Cervical rib and the scalenus syndrome, ganglionectomy, and surgery of the intervertebral disks are described and illustrated in a truly noteworthy manner.

VARICOSE VEINS. By *Alton Ochsner, B. A., M. D., D. Sc. (Hon.), F. A. C. S.; William Henderson, Professor of Surgery and Director of the Department of Surgery, School of Medicine, Tulane University of Louisiana;* and *Howard Mahorner, B. A., M. D., M. S. (Surgery), F. A. C. S., Assistant Professor of Surgery, School of Medicine, Tulane University of Louisiana, New Orleans, La.* Pp. 138. Ill. 52. C. V. Mosby Company, St. Louis. 1939. Price, $3.

Injection treatment of varicose veins has come to be so generally accepted as a routine treatment that many are using it in cases for which it is not adapted. A warning is sounded by these authors that many patients will not be benefited and others will suffer irreparable damage if the superficial veins be sclerosed. They give definite directions for determining which cases are suitable, together with minute instructions covering every detail of the injection treatment and the various surgical operations.

Hospitals and dispensaries where work of this sort is done should not be without this valuable book.

INJECTION TREATMENT OF HERNIA AND HYDROCELE. By *Lawrence Goldbacher, M. D., Formerly chief of Hernia Clinic, Shelter for the Homeless; Chief of Department of Proctology, Women's Homeopathic Hospital; Lieutenant Commander, U. S. N. R.* Pp. 189. Ill. 58. L. Aubrook & Co., Philadelphia, 1938. Price $5.75.

Books on this subject published as recently as 2 or 3 years ago had long introductory chapters of argument, designed to break down the general prejudice against the injection method. The general acceptance and widespread use of this procedure now make the apologia unnecessary.

This is essentially a practical handbook, with detailed descriptions of the technic and of the preparation of the fluids. It is based on 5 years' experience in several clinics. The author recommends the use of simple sclerosing solutions, prepared by the physician himself, instead of the widely-advertised and costly proprietary preparations. He

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prefers a mixture of phenol, glycerin, and water, costing only a few cents.

OPERATIVE ORTHOEPEDICS. By *Willis C. Campbell, M. D., Memphis, Tenn.* Pp. 1126. Ill. 845. C. V. Mosby Co., St. Louis, 1939. Price $12.50.

It would be difficult to think of an orthopedic lesion for which operation has never been recommended, so this volume on the operative aspect covers practically the whole orthopedic field. It is written by an acknowledged authority, with a background of many years of active work in his specialty. Both general and industrial surgeons will find here the material they need for routine or emergency work.

A TREATISE ON THE SURGICAL TECHNIQUE OF OTORHINOLARYNGOLOGY by *Georges Portman, Professor of otorhinolaryngology at the Medical School of the University of Bordeaux.* Collaborators, *H. Retrouvez, J. Despons, P. Leduc,* and *G. Martinaud, attending clinicians of the otorhinolaryngology department of the School of Medicine of the University of Bordeaux.* Translation by *Pierre Viole, M. D., associate clinical professor of surgery in the Department of Otorhinolaryngology of the University of Southern California School of Medicine.* 474 illustrations, 2 colored plates, 675 pages. William Wood and company, Medical Division, The Williams and Wilkins Company, Baltimore, 1939. Price $12.

This treatise on otorhinolaryngology is handled in an ideal manner. It is completely comprehensive in scope, yet, briefly done, profusely illustrated, yet each illustration with its terse description presents an excellent picture of the operation under discussion. The procedure for operation of the mastoid is a good example. Following a definition, the author gives: I. Indications for operation (*a*) local, (*b*) general. II. Preparation of the patient. III Anesthesia, general and local, with brief description. IV. Instruments, (*a*) surgeons' table, (*b*) assistants' table, naming the instruments, etc., in use and showing a picture of the table with the instruments laid out. V. Technic lighting, position of the patient, position of the surgeon and his assistant, operative field. Then the operation with each step from the incision through to the final closure of the wound, beautifully illustrated and described. VI. Operative incidents such as opening of the lateral sinus or mastoid vein, etc. VII. Postoperative care with type of dressing, technic, normal course, local or general complications—all illustrated and described.

Although in all instances we may not agree with the authors' technic, yet, we must admire the simple but thorough procedures described and feel that none but an able student, thoroughly a master of his work could have written such a remarkable surgical treatise.

THE PRINCIPLES AND PRACTICE OF OPHTHALMIC SURGERY, by *Edmund B. Spaeth, M. D., Associate Professor of Ophthalmology in the Graduate School of Medicine of the University of Pennsylvania, Philadelphia; Ophthalmologist to the Orthopedic Hospital and Infirmary for Nervous Diseases, Philadelphia; Consultant in Ophthalmology to the Philadelphia Hospital for the Insane (Byferry); Assistant Ophthalmologist to the Rush Hospital, Philadelphia; Senior Assistant in the Peter*

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Ophthalmological Service, Graduate Hospital, Philadelphia; Assistant in the Laboratory for Special Examinations, Wills Hospital, Philadelphia; Fellow, The American College of Surgeons; Fellow, The Philadelphia College of Physicians; Fellow, The American Academy of Ophthalmology and Oto-Laryngology. First edition 835 pages, Lea and Febriger, Philadelphia, 1939. Price $10.

In this presentation of a surgical text for the eye, the author has given us an excellent reference book well and simply written embodying not alone his own surgical methods but the procedures of other surgeons. The book contains many fine pictures as well as diagramatic sketches which are of great aid in the understanding of the text. This book should be valuable to the practicing ophthalmologist for reference. There are 26 chapters ranging from anesthesia, general pathology of the orbit to traumatism of the globe and carrying us through all surgical conditions of the lacrimal apparatus, enucleation, symblepharon, ocular muscles, plastic surgery, trachoma, the sclera, the cornea, the lens, glaucoma, and retinal separation.

THE ART OF ANESTHESIA. By *Paluel J. Flagg, M. D., Visiting Anesthetist to Manhattan Eye and Ear Hospital, Consulting Anesthetist to St. Vincent's Hospital, New York,* etc. Sixth Edition, revised. Pp. 480. Ill. 161. J. B. Lippincott Co., Philadelphia. 1939. Price $6.

In the foreword Dr. Alexis Carrell states that Dr. Flagg has united the disassociated fields of anesthesia, resuscitation and oxygen therapy under the name of pneumatology. One will find considerable reference to this subject in the book.

So far as the use of ether for anesthesia is concerned, this is an excellent manual, complete, authoritative, and systematically arranged. The other inhalation anesthetics are also described and their use explained. Local and spinal anesthesia receive relatively little attention, and one is referred to the standard textbooks on the subject. Two hundred pages are devoted to chapters on various allied phases of anesthesia which fit well under the title of the art of anesthesia.

Taken as a whole, it is a book which will appeal to one interested in the art of anesthesia more than it will to the anesthetist.

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Volume 30. 1938. Pp. 993. Ill. 149. W. B. Saunders Company, Philadelphia, 1939. Price, $11.50.

There is no more reliable milestone marking the progress of medicine from year to year than the annual volume of the Mayo Clinic. No other book indicates so accurately the trend of the year in all branches of the medical sciences. This year, 32 articles are presented in full, 113 in abridged form and 112 in abstract, a full repast for the most voracious student. It is most interesting to examine the articles which appear in full, and speculate on their import for the future.

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For instance, there is one by H. E. Robertson on Ulcerative Gastritis and Residual Lesions, which holds up to view the once-popular diagnosis of "chronic gastritis" and endeavors to interpret it in the light of modern knowledge. Boothby and Lovelace describe their new oxygen inhaler, which is so rapidly supplanting oxygen rooms and tents. There are studies of peptic ulcer by internists, surgeons, and pathologists. More than 75 pages are devoted to papers on the genito-urinary organs, 60 pages to the ductless glands, 150 to the blood and circulatory organs, and other sections in proportion.

One passage, which alone is worth the price of the book, appears in an article by W. C. Alvarez on Advances in the Treatment of Indigestion, and suggests the modern approach to medicine from the psychic angle. "The greatest advance that could come in the field of gastrointestinal therapeutics today would come through the more widespread recognition of three facts: First, that in perhaps half the cases of severe indigestion, general prostration, and abdominal pain, no organic disease is to be found in the abdomen, and the causes of the trouble are constitutional inadequacy, psychopathy, nervousness, overwork, unhappiness, worry, fear, insomnia, fussiness, constipation, food sensitiveness, migraine, polyglandular disturbances, spondylitis, hypertension, menopausal storms, perhaps an impending divorce, or combinations of several of these causes; second, that almost all of these causes can be discovered only by the taking of a good history by a sympathetic and understanding physician who is not trying to see 20 new patients in the time that should be devoted to 5; and third, that the present-day practice of making a diagnosis in a moment by glancing at a sheaf of reports from laboratory workers, roentgenologists, and experts in the study of some one organ is bringing disaster to many patients. It is responsible for the making of many tragic mistakes and the performance of many futile operations." There is an infinite amount of equally good advice in this invaluable volume.

THE SURGICAL CLINICS OF NORTH AMERICA. June 1939. Pp. 269. Ill. 128. W. B. Saunders Co., Philadelphia. Published bimonthly, Price, cloth, $16 per year.

Here are nearly 300 pages, mostly on surgical technic, from the clinic of Frank H. Lahey, an acknowledged master of the craft. The principal clinics are on thyroidectomy, esophageal diverticulum, cholecystectomy and choledochostomy, subtotal gastrectomy, colonic surgery, hemorrhoids, pilonidal sinus, arthrotomy for removal of semilunar cartilage, malunited Pott's fracture, hallux valgus, encephalography, lobectomy, empyema, mastectomy, prostatectomy, hysterectomy and bronchoscopy.

An active surgeon can ill afford to miss a number of this important series of clinics.

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CANCER, ITS DIAGNOSIS AND TREATMENT, By *Max Cutler, M. D., Associate in Surgery, Northwestern University Medical School; Chairman, Scientific Committee, Chicago Tumor Institute; Consultant, Tumor Clinic and Director, Cancer Research, United States Veterans' Administration, Hines, Illinois;* and *Franz Buschke, M. D., Assistant Roentgenologist, Chicago Tumor Institute, Late Assistant, Roentgen Institute, University of Zurich;* Assisted by *Simeon T. Cantril, M. D., Director Tumor Institute, Swedish Hospital, Seattle; late Assistant, Chicago Tumor Institute.* First Edition; 757 pages, illustrated. W. B. Saunders Company, Philadelphia and London, 1939. Price $10.

The authors have collected a great many statistics concerning the occurrence and the treatment of cancer in various locations of the body. The roentgenological, surgical, and radium treatment of these conditions, as may be indicated, are given in detail.

The 346 illustrations include many photographs of patients, specimens, and diagrams of treatment methods. The telecurietherapy apparatus is among the pictures. There are 56 tables having to do principally with the results of treatment of the different forms of cancer in various locations of the body.

While, no doubt, a great many will be at variance with the methods, dosages, etc., as set forth in this book, nevertheless, it gives a fair idea of what has been and what is being done in the treatment of cancer. The book, being mostly about treatment, would be better named if the word "diagnosis" were omitted from the title.

It is recommended to everyone interested in cancer and its treatment. The bibliography is quite comprehensive.

CANCER HANDBOOK edited by *Eric Liljencrantz, M. D., Chief of Tumor Clinic, Stanford University School of Medicine.* First Edition. 114 pages. Illustrated. Stanford University Press, Stanford University, California, 1939. Price $3.

This small book, or syllabus, as the author calls it, deals with the cancer problem as it presents itself to us today.

The genesis, incidence, spread, diagnosis, and treatment of the commoner forms of malignancy are briefly discussed; the last two from the standpoint of the clinical management of patients with or suspected of having the disease. It makes a plea to the general practitioner to promptly send any early suspicious case to an organized tumor clinic rather than to temporize until too late.

The book contains 50 figures made up of tables, charts, and pictures, many of which are of general interest. A comprehensive bibliography is given and it is well indexed.

The book is recommended to all interested in the important problem of cancer.

ALLERGIC DISEASES by *Ray M. Balyeat, M. A., M. D., F. A. C. P., Associate Professor of Medicine and Lecturer on Diseases Due to Allergy, University of Oklahoma Medical School,* assisted by *Ralph Bowen, B. A., M. D., F. A. A. P., Chief of Pediatric Section, Balyeat Hay Fever and Asthma Clinic, Oklahoma*

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City. Fifth edition, revised and enlarged. 547 pages, illustrated with 145 engravings, including 8 in colors. F. A. Davis Co., Philadelphia, 1938. Price $6.

This latest edition of an invaluable work by an outstanding authority is obviously written primarily for the lay patient and the medical man who is not a specialist in allergy. This method has advantages and disadvantages. In about half the space required by more pretentious works at least 95 percent of the practical essentials are presented succinctly, clearly, and in very readable language. The almost complete absence of theory in a subject so replete with theory is a welcome relief; however, the student of the subject cannot dispense with it so readily. The book has no complete or coherent discussion of the present status of our knowledge of the nature and cause of the allergic state or of the several hypotheses adduced to explain it. This is a defect as one needs a yard stick by which to evaluate the numerous claims in the literature regarding pathogenesis and treatment often based on biochemical misconcepts.

The book also shows a remarkable absence of consideration of so-called physical allergy. The important subject of serum allergy is practically ignored. This is a serious deficiency.

The publisher is to be complimented on the paper, the large type, the excellent illustrations, and attractive format. Somewhat annoying are a number of printing errors where the text refers to the wrong illustration figures. In chapter 33, relating to the hereditary relationship of several allergic conditions, after wading through 5 pages of text referring to a number of almost unintelligible genealogical charts, one finds the key to the symbols used incorporated in the last chart and in print almost too fine to be read. This chapter could be greatly improved.

ANEMIA IN PRACTICE, Pernicious Anemia, by *William P. Murphy, A. B., M. D., Associate in Medicine, Harvard Medical School; Senior Associate in Medicine, Peter Bent Brigham Hospital, Boston; Consultant Haematologist, Melrose Hospital, Melrose, Mass.* First edition, 344 pages, illustrated. W. B. Saunders Co., Philadelphia and London, 1939. Price, $5.

This book deals primarily with pernicious anemia from the clinical standpoint. However, all the forms of anemia are discussed which gives a background for the diagnosis of pernicious anemia.

There are four very interesting and instructive chapters concerning liver therapy. The development, use, effect, comparative efficiency, and cost of the various forms of liver preparations are discussed. The chapter on practical management and education of the patient is quite valuable to the practitioner. The section dealing with laboratory procedures is likewise written for the clinician and not for the technician. The illustrations are few in number and consist mostly of a few excellently colored blood films and of tables and

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charts. However, this is a type of book which does not require many pictures.

The author's style of writing lends to easy reading and the book is well bound and printed. It should be of interest to physician and surgeon alike and is especially recommended to those treating the anemias.

NEURO-OPHTHALMOLOGY, by *R. Lindsay Rea*, C. V. Mosby & Co., St. Louis. 1938. Price $9.

This book was written because of the need for a text to serve as a connecting link between ophthalmology and neurology. It is the most comprehensive book on this subject known to this reviewer and as such is obviously a book for the specialist.

The chapters on Interpretation and Location of Lesions in the Visual Pathway as shown by the perimeter and the Localizing Value of Ocular Symptoms in the diagnosis of diseases of the brain are outstanding.

There is an extensive bibliography appended to this text containing the names of authors and their writings on material of a neuro-ophthalmological nature.

CLINICAL GASTROENTEROLOGY, by *Horace W. Soper, M. D., F. A. C. P.* C. V. Mosby Co., St. Louis, 1939. Price, $6.

The characteristic feature of this book is that it expresses the pet aversions and likes of the author toward some food or remedies, and gives individualized therapeutic procedures with which the author was successful in his rather opulent practice. Raw and pasteurized milk are objects of his wrath and the reasons given why they are so harmful to civilized humanity are quite interesting even though not convincing. Also, most clinicians do not share his optimism in 4-to-8-week cures of ulcerative colitis and his enthusiasm for Bargen's vaccine.

The author is a great advocate of mineral oil retention enemas, in contradiction to opinions of many who find mineral oil very detrimental to the intestinal mucosa.

For detection of occult blood, the author uses guaiac test, again differing with most recent laboratory textbooks that recommend its discard for better tests, such as, that of Gregerson and Boas.

The book is written in a facile, concise style. The chapters on "Small Intestines" and "Proctosigmoidoscopy" were excellently presented and of practical importance. The roentgen tables were well reproduced and amply illustrate the clinical expositions. As a textbook, this work is too subjective; as a reference book it is not sufficiently illuminating.

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DISEASES OF THE MOUTH AND THEIR TREATMENT. By *Hermann Prinz, D. D. S., M. D., D. Sc., Professor Emeritus of Materia Medica and Therapeutics, School of Dentistry, University of Pennsylvania,* and *Sigmund S. Greenbaum, B. S., M. D., F. A. C. P., Professor of Clinical Dermatology and Syphilology, Graduate School of Medicine, University of Pennsylvania, etc.* Second edition. Pp. 649. Ill. 336. Lea & Febiger, Philadelphia, 1939. Price, $9.

A second edition following so quickly upon the heels of the first indicates that this book has been favorably received and must possess certain virtues. This is especially true since it is in direct competition with at least two other well-known texts on the same subject.

So far as completeness is concerned, little fault can be found, except that, in some cases, so many data are presented with no effort at evaluation, that one is left helpless to select the valuable from the useless. As a compilation, it is probably quite complete, but as a guide for treatment it lacks value. Probably it is best adapted for a textbook and reference work for students.

HISTOPATHOLOGY OF THE TEETH AND THEIR SURROUNDING STRUCTURES. By *Rudolf Kronfeld, B. S., M. D., D. D. S., Professor of Dental Histology and Pathology in the College of Dental Surgery, School of Dentistry, Loyola University, Chicago, Illinois; Worker of the Foundation for Dental Research of the Chicago College of Dental Surgery; Fellow of the American Academy of Periodontology; former Assistant at the Dental Institute of the University of Vienna, Austria.* Second edition, 493 pages, 438 illustrations, Lea & Febiger, Philadelphia, 1939. Price, $7.

The second edition enlarged, rearranged and completely rewritten demonstrates conclusively the rapid progress in microscopic dental research. Designed to meet the needs of both dental student and active practitioner controversial and inconsequential details are omitted as far as possible resulting in an unbiased survey of present-day knowledge of the various subjects.

The bibliography is confined to recent publications that can easily be secured.

Due to the diversity of the subject matter treated, space does not permit elaboration on any one subject; however, the answers to many perplexing questions are recorded.

TRAUMA AND INTERNAL DISEASE. By *Frank W. Spicer, A. B., M. D., F. A. C. P.* Pp. 549. Ill. 43. J. B. Lippincott Co., Philadelphia, 1939. $7.

Ten million accidents annually in this country lead to an enormous amount of litigation, frequently involving medical testimony. Many medicolegal and pseudomedical questions are asked of the witnesses which they are not prepared to answer with the proper background of data and experience. The medical man often finds himself tricked into statements and opinions which are unsupportable and which may be entirely foreign to his beliefs.

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This book leads one on an excursion in those obscure boundaries between medicine and law, where the physician most needs a reliable guide. It discusses the effect of trauma on the various parts and organs, giving the best available information and statistics. It should prove most valuable both for the lawyer and for the physician who may be called upon to testify concerning posttraumatic disabilities.

SYPHILIS SIVE MORBUS HUMANUS, A Rationalization of Yaws So-Called. For Scientists and Laymen Interested in the Damage to Man from Venereal Diseases. By *Charles S. Butler, A. B., M. D., LL. D. Rear Admiral (MC) U. S. Navy. Member American Academy of Tropical Medicine, Fellow New York Academy of Medicine. President (1935–36) New York Society of Tropical Medicine. Commanding Officer, U. S. N. Medical Center, Washington, D. C., 1936–38.* College edition. The Science Press Printing Co., Lancaster, Pa. Price, $3.

Admiral Butler's book has been previously reviewed in this Bulletin, and its contents are well known to many naval medical officers as well as scientists and laymen. The object of the work as stated in the preface is three-fold. First, to popularize a knowledge of syphilis; second, to dispose of the myth of its recent American origin in Europe and Asia; and third, to logically synthetize his exceptional opportunity for observation into the unity of yaws with syphilis. The previous edition consisted of 137 pages, this second of 174, for many pages of new matter have been added.

The work is unusual, for it represents the untiring altruism of a man skilled and experienced in tropical medicine carrying on a campaign against scientific error, having origins in a European heritage of deceit and prejudice. Some accusations particularly hazardous to the career of a naval medical officer, with which he has had to contend, will be clearly revealed by a perusal of pages 129 to 132, and from which each reader may form his own opinion.

Much of the material in the first edition remains unchanged. At the end of each chapter are references to published papers which deal with the subject at greater length. Chapter IV contains added material dealing with bejel, the endemic syphilis of the Arab of the upper Euphrates valley. Chapter V, on nomenclature, recalls some information that the arbiters of medical writing might peruse with profit and verify. From pages 129 to 153, under the title De Mortuis Nil Nisi Bonum, is included new material, dealing with personal attacks upon his professional standing and opinion.

Whatever may be the persuasions of anyone who will read this interesting book, if the author does not convince him of the purpose for which it was written, he will at least give the thoughtful or experienced reader a lot to think about.

The reviewer has followed Admiral Butler's work through many years, and takes pleasure in recording here an admiration for courage

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displayed in the face of obstacles that have been put forth, to prevent him from telling the results of his long and unusual experience with the disease of which he writes.

The place of syphilis in the history of the race is a long way from a finished problem, and the attempt in some quarters to overlook and equivocate its long and awful prevalence because of ancient European war-hatreds, prejudices, traditionalisms based on long obsolete humoral physiology and pathology, has no vitrue of finality in the light of modern knowledge.

SYPHILIS AND ITS ACCOMPLICES IN MISCHIEF. Society, and the Physician, by *George M. Katsainos, M. D.*, pages 676, with appendix. Privately printed at Athens, Greece. Price $5.

This privately printed publication is not listed in the Cumulative Book Index. A previous publication "Marriage and Syphilis," listed as being published in 1923, has been incorporated in this present work.

The author, a native of Arcadia, Greece, studied medicine in France and spent several years of professional life in Boston, Mass. He frankly admits the imperfections of his work and his recital of efforts to have his manuscript accepted for publication is an illustration of admirable tireless persistence.

The author states that he is motivated by a desire to remove the social stigma suffered by the syphilitic. Doubtless, in past years, for reasons of prudery, such a discussion was objectionable. However, there are more fundamental defects in this publication. The writer digresses far from his main objective. Syphilis is hardly mentioned in a lengthy introduction which deals with the political and economic consequences of the Treaty of Versailles. The author also becomes involved in a lengthy discussion of the controversial issue as to the origin of syphilis. He adds only confusion to this problem which is so dominated by continental, racial, and personal prejudice.

His attitude toward the modern methods of diagnosis and treatment is reactionary. He includes an interesting account of the use of mercury by the Greeks, Arabs, and the later Latin writers. American and French authorities are quoted voluminously. Although much of this material is not brought down to date, it is not far behind that of the average textbook on this subject. The reviewer found many parts of the work instructive and entertaining. As it represents the rumblings recently forecast by Stokes and Ingraham and Kolmer as to the dangers attending the recent passage of State laws making a Wassermann test obligitory for marriage, it suggests a little heed to some of the problems the matter presents before the storm breaks. This author believes that differences in opinion as to measures of diagnosis and treatment will be better settled within the profession, than by forcing the decision to a matter of law and regulation, thus repeating the experience had with prohibition.

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GONORRHEA IN THE MALE AND FEMALE, A Book for Practitioners, by *P. S. Pelouze, M. D., assistant professor of urology, University of Pennsylvania; consulting urologist to Delaware County Hospital; special consultant to United States Public Health Service; member of Board of Directors, American Social Hygiene Association and American Neisserian Medical Society.* Third edition, thoroughly revised. W. B. Saunders Company, Philadelphia and London. 1939. Price, $6.

In this third edition the author has deleted much of the unnecessary material in the previous edition, rearranged, amplified, and added new material, thereby bringing the book up to the present scientific concepts of the disease. Sixteen new chapters, many new illustrations, charts, and tables have been added. In the new chapters such subjects as prolonged hyperthermia, sulfanilamide and its derivatives, estrogenic harmones in treatment, advances in cultural methods, "The Medical Profession and Gonorrhea Control," etc., have been introduced.

CRYSTALLINE ENZYMES. The Chemistry of Pepsin, Trypsin, and Bacteriophage, by *John H. Northrop, Member of the Rockefeller Institute for Medical Research.* First Edition. 176 pages. Illustrated. Columbia University Press, New York. 1939. Price, $3.

This monograph is intended for the biochemist or research worker interested in the chemistry of the proteolytic enzymes and bacteriophage rather than the general practitioner of medicine. It is beyond the ordinary scope of clinical chemistry and makes no attempt at clinical application.

Following a brief discussion on the general chemistry of enzymes the author outlines and discusses the results of the investigation carried out in his laboratories at the Rockefeller Institute for Medical Research, leading to the obtaining of the gastric enzymes, pepsin, and its precursor pepsinogen, as well as trypsin, trypsinogen, and allied pancreatic enzymes in the form of a pure crystalline protein. The general properties of each such as specificity, iso-electric point, molecular weight, ultraviolet spectra, the effect of the hydrogen-ion concentration of the solution on the rate of activation and inactivation, the diffusion coefficient, and other properties are discussed.

The author has been unable to crystallize bacteriophage, but his experimental results with it resemble so closely those with the enzymes as to suggest that perhaps it belongs with that group. His studies show it to have the composition of a nucleoprotein. But as is well brought out, not until the mechanism of phage formation is understood can we say that it resembles cells or enzymes. If it uses energy to synthesize itself, it is analagous to cells; if it forms from previously synthesized molecules it is analagous to the enzymes.

The book is well printed, well indexed and the text augmented by 35 tables and illustrations. Among the illustrations are photographs of the various enzyme crystals. Following the text there is an appen-

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dix in which is described the method used in the preparation and crystallization of the enzymes as well as the method of preparation and purification of phage and its quantitative determination in solution. The bibliography is complete.

This book is recommended to those interested in the technical aspects of this phase of digestive chemistry.

ELEMENTARY ANATOMY AND PHYSIOLOGY by *James Whillis, M. D., M. S., F. R. C. S., University Reader in Anatomy, Guy's Hospital Medical School; late Lecturer in Anatomy in the University of Durham.* Illustrated with 87 cuts prepared from original drawings by Pauline Lariviére. Lea and Febiger, Philadelphia, 1939. Price $3.50.

This publication contains 328 pages of subject matter presented in an exceptionally clear and understandable manner. The illustrations are particularly well adapted to the text and are well selected.

The author presents the subject of anatomy and physiology in such a manner that students of nursing and members of the hospital corps of military and naval services can ill afford to be without it as a reference book in these subjects.

An excellent publication and one recommended for reference libraries of institutions where instruction in nursing is conducted, and as expressed in the foreword, it is of value to students during their first year of medicine.

PRINCIPLES OF HAEMATOLOGY, by *Russell L. Haden, M. A., M. D., Chief of the Medical Division of the Cleveland Clinic, Cleveland, Ohio; formerly Professor of Experimental Medicine in the University of Kansas School of Medicine, Kansas City, Kansas.* First Edition; 348 pages, illustrated. Lea & Febiger, Philadelphia, 1939. Price $4.50.

This book covers the usual technical hematological methods as well as the important diseases which manifest themselves in the blood. Contrary to most books on hematology this one comes within the range of the pocketbook of students and physicians alike and is brief enough to be read. There are many good illustrations and diagrams in black and white. The diagrams concerning the mechanisms of blood production, of anemias of polycythemia, of leucocytosis, leukopenia, and clotting are most ingenious and they help greatly in the gaining of a concept of these conditions.

The book is very well put up and is recommended to every student of medicine, undergraduate or graduate.

TEXTBOOK OF PATHOLOGY, by *Charles W. Duval, M. D., Professor of Pathology and Bacteriology, Tulane University School of Medicine; Chief Visiting Pathologist, Charity Hospital, New Orleans; Consultant in Pathology, Touro Infirmary, New Orleans;* and by *Herbert J. Schattenberg, M. D., Associate Professor of Pathology and Bacteriology, Tulane University School of Medicine; Visiting Pathologist, Charity Hospital, New Orleans.* First edition, 681 pages, illustrated. D. Appleton-Century Co., New York and London, 1939. Price $8.50.

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This book is another new text of pathology that deals with the usual subjects and offers no advantage over any one of the new editions of a number of the older ones.

According to the authors, Goldberger's work on pellagra is not convincing and they subscribe to the infectious (virus) origin. They also believe that *B. leprae* (chrome) of Clegg is probably the etiological agent in human leprosy.

In the classification of kidney diseases they still use the names, parenchymatous and interstitial nephritis; but have put under these headings what a number of other authors class as glomerular, arteriolosclerotic and arteriosclerotic lesions. This tends to confusion. The section on neoplasia is somewhat more sketchy than the average. Following the discussions as to the etiology and pathological changes of the diseases in nearly every case there is an excellent section on the correlation of the clinical and pathological findings.

The book contains numerous original illustrations, mostly in black and white, many of which are very good. It is of convenient size and is well bound and printed, but cannot be recommended over many of the previously existing text books of pathology.

BERGEY'S MANUAL OF DETERMINATIVE BACTERIOLOGY, by *David H. Bergey, formerly of the University of Pennsylvania, Philadelphia, Pa.; Robert S. Breed, New York State Experimental Station (Cornell University), Geneva, New York; E. G. D. Murray, McGill University, Montreal, P. Q., Canada;* and *A. Parker Hitchens, University of Pennsylvania, Philadelphia, Pa.;* and assisted by *R. E. Buchanan, H. J. Conn, E. B. Fred, I. L. Baldwin, W. H. Burkholder, C. D. Kelly, A. W. Hofer, Sara E. Branham, Karl F. Meyer, Alice C. Evans, Margaret Pittman, G. J. Hucker, J. M. Sherman, C. S. Pederson, L. F. Rettger, C. B. Van Niel, M. W. Yale, Frederick Smith, F. D. Chester, R. S. Spray, G. B. Reed, T. E. Roy, S. A. Waksman, A. T. Henrici, G. P. Van Eseltine, and others.* Fifth edition. 1,032 pages. The Williams and Wilkins Company, Baltimore, 1939. Price $10.

This book, a monumental accomplishment on the part of the authors and their many able assistants, brings to the field of bacteriology a systematic classification based upon sound scientific principles and upon the cooperative understanding and collaboration of a large international group.

For years the need for a universal bacterial nomenclature has been recognized and tribute is paid to the many valuable contributions endeavoring to unify the loose and unsystematic naming which has existed since the early days and which has been ever increasing with the accelerating growth in bacteriological knowledge.

It is inevitable that precise finality cannot be achieved by any classification in a field of rapid expansion and changing concept, so that with this and succeeding editions one must be prepared to find an old friend with a new name from time to time and to make such other personal sacrifices as the ultimate good of the cause seems to dictate.

The general plan and arrangement of the main substance of the book is highly workable as before.

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There is included a chapter giving an excellent survey of previous classifications, a very instructive chapter on "How Bacteria are Named and Identified" and a most important chapter on "Rules of Nomenclature."

This edition contains descriptions of 1,335 bacterial species with references to the original place of publication of 5,600 descriptions, thus making it, even more than the fourth edition, an indispensable item of the bacteriologist's fundamental equipment, and in addition, an invaluable reference book.

CLINICAL BIOCHEMISTRY by *Abraham Cantarow, M. D., Associate Professor of Medicine, Jefferson Medical College; Biochemist, Jefferson Hospital* and *Max Trumper, Ph. D., Clinical Chemist and Toxicologist; formerly in charge of the laboratories of biochemistry of the Jefferson Medical College and Hospital.* Second Edition, 666 pages, W. B. Saunders Co., Philadelphia. 1939, Price $6.

This work represents the second edition of a popular and worthwhile book. The title of the first edition was "Biochemistry In Internal Medicine". The authors feel that the present title expresses better the "broad scope of application of biochemical observations in modern clinical medicine." More than 200 pages and ten new chapters have been added. Most of the previous chapters have been rewritten or revised. This extensive revision and supplementation has of course been necessitated by the rapid development in the field of applied biochemistry.

It is obviously a difficult problem for authors to decide where to stop in the discussion of normal and pathological physiology, a really all inclusive field. Apparently this necessity of limitation brings some of the discussions to a premature end. It is perhaps too much to hope that the perfect book on such a subject will ever be written. Constant improvements however will bring us closer to the goal. Students and clinicians should often feel the need of amplifying and extending their knowledge of many of these subjects beyond the scope of the discussion given. They should frequently refer to a book on applied physiology and follow the problem farther than a book on clinical biochemistry can take them.

New chapters in this second edition discuss the following subjects: Influence of the anterior hypophysis, adrenal cortex and vitamin B_1 on carbohydrate metabolism; sodium and potassium metabolism; iron metabolism; magnesium metabolism; chemistry of bile; and practical biochemical aspects of vitamin deficiency. The discussions are well written and practical in their application though sometimes limited in scope. The index is well done. The type is clear and readable; the paper and binding are excellent. It is a book that should find an even larger demand than the first edition.

AN INTRODUCTORY GUIDE TO BIOCHEMISTRY by *Sidney Bliss, Ph. D., Professor of Biochemistry, Tulane University School of Medicine.* First Edition, 103 pages, W. B. Saunders Co., Phila., Pa. 1939. Cloth; Price, $1.25.

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This little pocket-size book aims to interest the student in the subject of biochemistry by presenting it in the simplest terms. Not a single chemical formula is given. The story of biochemistry is told in thirteen interesting pithy chapters which cover biochemistry from enzymes and digestion to vitamins, hormones, detoxification, and chemotherapy. The complete avoidance of chemical symbols is prompted by a knowledge of what ordinarily discourages the student in beginning such a subject. The student will have to be a wary one or he will find himself liking the subject before he realizes that he has begun to study.

CLINICAL LABORATORY METHODS AND DIAGNOSIS, by *R. B. H. Gradwohl, M. D., Director of the Gradwohl Laboratories and Gradwohl School of Laboratory Technique; formerly Director of Laboratories, St. Louis County Hospital, Pathologist to Christian Hospital; Director, Research Laboratory, St. Louis Metropolitan Police Department, St. Louis, Mo.; Commander, Medical Corps, Fleet, United States Naval Reserve.* Second Edition; 1607 pages, 492 illustrations; 44 color plates. C. V. Mosby Company; St. Louis, 1938. Price, $12.50.

This book weighs 8 pounds and is a compilation of useful and obsolete laboratory methods, but is not complete enough to be classed as an encyclopedia.

In numerous instances a number of different methods are given for performing a particular test, some of which are good, while others are not so good; but the relative merits of these methods are not given. The section on tropical medicine and parasitology contains considerable material taken from old data which have not been revised in the light of newer knowledge.

The section on detection of crime by laboratory methods is of questionable value.

However, the book contains much valuable information and many excellent pictures concerning practically all phases of clinical laboratory methods and is recommended as a library reference but not as a manual for technicians.

LABORATORY MANUAL OF THE MASSACHUSETTS GENERAL HOSPITAL by *Francis T. Hunter, M. D.*, Third Edition. 119 pages, Lea and Febiger, Philadelphia, Pa. 1939. Cloth, Price $1.75.

The first edition of this manual was brought out in 1922 as a pocket outline of the routine laboratory work done by internes in the Massachusetts General Hospital. It has been revised and today represents the interne activity in this field in this large and busy hospital. It is not a work on clinical pathology. Subjects covered are: Examination of specimens; collection of specimens; special diagnostic procedures; therapeutic technic; and, prophylactic measures. The book is definitely not a clinical pathology but an interne's guide in the simple and routine work of a practical modern hospital service.

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A TREATISE ON PHARMACY for students and pharmacists by *Charles Caspari, Jr., late Dean and Professor of Pharmacy in the Department of Pharmacy of the University of Maryland (Maryland College of Pharmacy, 1841–1904)*. Eighth Edition, thoroughly revised by *E. F. Kelly, Advisory Dean and former Professor of Pharmacy in the School of Pharmacy of the University of Maryland (Maryland College of Pharmacy, 1841–1904)*. Lea and Febiger, Philadelphia. Price $6.50.

This text book is the eighth edition and is based on the eleventh revision of the United States Pharmacopoeia and the sixth edition (1936) of the National Formulary.

The book contains 266 excellent engravings, a comprehensive index, and is printed on a fine grade of white paper with clear type.

It is a good text book on pharmacy for students who have had previous training in chemistry but is not as suitable for hospital corpsmen who have not had preliminary courses in chemistry as other textbooks on the subject which devote several chapters to pharmaceutical organic and inorganic chemistry before beginning discussion of theoretical and operative pharmacy.

The text is well arranged and has been grouped under two main headings:

Part I, General Pharmacy, includes the study of the pharmaceutical standards, the systems of measurements, the physical constants, the forms of energy, the pharmaceutical processes, and the classes of material used in the manufacture of medicinal preparations.

Part II includes the study of the preparation, preservation, and dispensing of the various classes of medicinal preparations.

To the reviewer's mind, its greatest value is the success with which the many questions as to the why and wherefore of the official directions and tests are answered.

It is a worth-while book and is recommended to chief pharmacist's mates preparing for the pharmacist's examination and as a quick reference for hospital corpsmen on duty in pharmacies.

THE LIFE AND LETTERS OF DR. WILLIAM BEAUMONT, by *Jesse S. Myer, A. B., M. D. Late Associate in Medicine in Washington University, St. Louis.* With an introduction by *Sir William Osler, Bt., M. D., F. R. S., Late Regius Professor of Medicine in Oxford University, England.* 327 pages and many illustrations, one in color. A new print of the original 1912 edition. C. V. Mosby Company, St. Louis, 1939. Price $5.

The virtual founder of experimental physiology was Galen, who was born in 131 A. D. and died in 201 A. D. His work remained practically the only really important contribution to physiology until Harvey published his famous discovery of the circulation of the blood in 1628, a period of nearly 15 centuries. It is not too much to say that a lapse of 2 more centuries occurred before another really notable discovery in physiology was recorded, this time the work of an American, the Army surgeon William Beaumont, who in 1833 published his "Experiments and Observations on the Gastric Juice and the Physiology of Digestion," now justly regarded as one of the classics of medicine and science.

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Most of the textbooks of physiology in use in the American grade schools once contained the account of the accidental gunshot wound of the stomach received by the trapper Alexis St. Martin, and of Beaumont's observations through the gastric fistula that developed. A whole generation of American school children were familiar with the story and the writer hopes that the textbooks of today still tell it, as it is one of the most entertaining and romantic in the history of science.

Beaumont's discoveries in gastric physiology may be summarized as follows:

1. First description of normal gastric mucosa in life.
2. First account of gastric movements during digestion.
3. Gastric juice secreted only when food is present and that mechanical irritation of the gastric mucosa causes only conjestion, but practically no secretion.
4. Description of the effects of the gastric juice on various types of foods, and times required for digestion, the basis of all modern tables on the subject.
5. First chemical analysis of the pure gastric juice.
6. Demonstrated that the gastric juice contained hydrochloric acid and another digestive agent (later shown by Schwann to be pepsin).

These constitute probably the greatest single contribution to the physiology of digestion ever made by one man and this by an obscure Army surgeon in a backwoods Army post. Dr. Myer's book gives an excellent account of the circumstances under which these discoveries were made. There are copious extracts from Beaumont's note books and journals and numerous facsimiles of important documents and illustrations of persons and scenes by which Beaumont was surrounded at the time his important work was done.

Beaumont was as interesting a personality as he was a scientist. Shortly after his first promotion, he says that "he conceived the bold and arduous project of arriving at moral perfection," no slight ambition. He made a list of thirteen virtues and in a little book he allotted a page to each and ruled the page in red ink with seven spaces for the days of the week. He then gave himself a black mark for every fault committed that day. His description of this episode alone is worth the price of Dr. Myer's book, although unfortunately, like Benjamin Franklin, who did the same thing and inspired Beaumont's attempt, he did not tell how near he came to success.

Every physician who reads this work of Beaumont will have a better understanding or gastric physiology and be better able to deal with patients with gastric complaints. He will also meet one of the most interesting personalities in the history of medicine. Of his discoveries we should be particularly proud, for what he did was a typically American achievement, not only pioneer work in physiology, but also made under primitive frontier conditions characteristic of our country at the time.

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THE DIVISION OF PREVENTIVE MEDICINE

Commander C. S. Stephenson, Medical Corps, United States Navy, in charge.

TOXIC EFFECTS OF ARSENICAL COMPOUNDS

AS ADMINISTERED IN THE UNITED STATES NAVY IN 1938 WITH SPECIAL REFERENCE TO ARSENICAL DERMATITIS

By Commander C. S. Stephenson, Medical Corps, United States Navy, and W. M. Chambers, Chief Pharmacist's Mate, United States Navy

For the past 14 years medical officers of the Navy have been required to submit to the Bureau of Medicine and Surgery monthly reports of the number of doses of arsenicals administered and the reactions therefrom. This information has been compiled and published in the following United States Naval Medical Bulletins:

September 1925	April 1933	October 1936
January 1927	October 1933	January 1937
January 1929	October 1934	October 1937
July 1930	January 1935	January 1938
October 1931	October 1935	October 1938
October 1932	January 1936	January 1939

In table 1 are shown the number of doses of each arsenical administered in the year 1938, the reported reactions which occurred, and similar data for the 14-year period 1925–38. It is noted that in 1938 there was 1 reaction to 3,097 doses and 1 death to 41,059 doses. For the 14-year period 1925–38 there was 1 reaction to 1,415 doses and 1 death to 31,151 doses.

TABLE 1.—*Arsenicals, U. S. Navy, 1938 and 1925–38—type of drug, reaction, and ratio of doses to reactions*

	Number of doses administered	Reactions				Ratio of reactions to doses 1 to—	Ratio of deaths to doses 1 to—
		Mild	Severe	Fatal	Total		
Year 1938:							
Acetarsone	26	1	0	0	1	26	0
Bismarsen	557	0	0	0	0	0	0
Mapharsen	42,755	5	2	0	7	6,108	0
Neoarsphenamine	71,694	17	12	3	32	2,240	23,898
Silver arsphenamine	0	0	0	0	0	0	0
Sulpharsphenamine	1,951	0	0	0	0	0	0
Tryparsamide	6,193	0	0	0	0	0	0
Total	123,176	23	14	3	40	3,079	41,059
14-year period 1925–38:							
Acetarsone[a]	971	1	0	0	1	971	0
Arsphenamine	41,558	27	14	1	42	989	41,558
Bismarsen[b]	2,447	0	0	0	0	0	0
Mapharsen[c]	56,290	5	3	0	8	7,036	0
Neoarsphenamine	1,244,537	597	290	45	932	1,335	27,656
Silver arsphenamine[d]	586	0	1	0	1	586	0
Sulpharsphenamine	28,495	17	8	0	25	1,140	0
Tryparsamide	58,056	3	1	0	4	14,514	0
Total	1,432,940	650	317	46	1,013	1,415	31,151

[a] First administered during the year 1932.
[b] First administered during the year 1929.
[c] First administered during the year 1935.
[d] First administered during the year 1931.

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TABLE 2.—*Arsenical reactions, U. S. Navy, 1938*

Classification	Cases	Deaths	Classification	Cases	Deaths
Arsenical dermatitis	25	2	Gastro-intestinal	2	0
Vasomotor phenomena	7	0			
Blood dyscrasias	3	1	Total	40	3
Liver damage	3	0			

From table 2 it may be seen that the most frequent reactions are those that are classified as arsenical dermatitis and vasomotor phenomena. Dermatitis in some form was observed in 62.50 percent of the cases. In 1937 dermatitis was observed in 53.06 percent of the cases.

TABLE 3.—*Proportion of reactions of various types, 1929–38*

Classification	Number of reactions	Percent of total reactions
Vasomotor phenomena	333	42.86
Arsenical dermatitis	286	36.81
Blood dyscrasias	37	4.76
Liver damage	29	3.73
Table reactions	26	3.35
Reactions of minor importance	17	2.19
Jarisch-Herxheimer	17	2.19
Gastro-intestinal	15	1.93
Hemorrhagic encephalitis	8	1.03
Optic neuritis	3	0.39
Arsenical neuritis	2	0.26
Acute renal damage	1	0.13
Border line, hemorrhagic encephalitis	1	0.13
Liver damage (doubtful reaction)	1	0.13
Vascular damage (probable adrenal hemorrhage)	1	0.13
Total	777	100.00

In this article will appear a brief summary of the clinical history of each of the 25 cases of arsenical dermatitis.

ARSENICAL DERMATITIS

The 25 cases of arsenical dermatitis in 1938 were classified as 13 mild, 10 severe, and 2 fatal reactions. The type of lesion was erythematous in 10 instances, exfoliative in 7, macular in 4, maculopapular in 2, urticaria in 1, and scarlatiniform in 1.

MILD REACTIONS

The 13 mild reactions occurred after the following number of injections: 1 after the first injection, 6 after the second, 2 after the third, and 1 each after the sixth, seventh, thirty-second, and seventieth. One mild reaction occurred after the eighth dose of stovarsol administered orally.

The interval between injection and appearance of symptoms varied from 1 hour to 8 days.

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The length of time required for complete recovery varied from 10 hours to 57 days.

A brief history of each case is cited.

Neoarsphenamine

(*1–1938.*) Following exposure to infection on February 22, 1938, this patient developed a nonindurated greasy based ulcer on glans penis. A darkfield examination of the ulcer was positive for *Treponema pallidum.* A Kahn blood test was negative.

Arsenical treatment was instituted on March 2, 1938, with a 0.3 gram injection of neoarsphenamine, followed by a 0.45 gram injection on March 7, and 0.6 gram injections on March 10, 17, 24, and 31, a total of 3.15 grams. No concurrent treatment was given in this case.

Six days after the last injection the patient developed a rash on extremities and trunk which consisted of red papules agminated in some places. The rash was itchy when patient became warm and perspired. Papules subsided in 2 weeks, but some discoloration remained for an additional 2 weeks. Recovery in 14 days.

(*2–1938.*) Following exposure on January 25, 1938, this patient developed a penile lesion which was positive for *Treponema pallidum.* A Kahn blood test was 4-plus on February 17.

He was given a 0.3 gram injection of neoarsphenamine on February 18, and a 0.45 gram injection on February 23. As concurrent treatment he received one fluid dram of mixed treatment t. i. d.

Forty-eight hours after the last injection of neoarsphenamine the patient developed a slight chill, followed by a temperature of 102°. Four days later a macular rash appeared over the chest, back, and abdomen and his temperature rose to 105°. He was given one gram of sodium thiosulphate intravenously on February 25, 26, 28, and March 1, 1938. The temperature gradually returned to normal and the rash subsided. Recovery within 6 days.

(*3–1938.*) One month after exposure to infection on December 16, 1937, this patient developed a penile lesion which was positive for *Treponema pallidum.*

He was given a 0.3 gram injection of neoarsphenamine on January 10, 1938, and a 0.45 gram injection on January 15. Seven days later the patient reported for the third injection of neoarsphenamine, and at this time an examination revealed a shower of moist desquamating papules on the arms and trunk. The rash developed into an erythematous maculopapular eruption over the upper arms, thorax, and thighs. There were no constitutional symptoms, and 4 days later a slight desquamation of the lesions was noted. Recovery in 9 days.

(*4–1938.*) Fifteen days after exposure to infection on March 10, 1938, this patient developed a demarcated lesion on the penis which was positive for *Treponema pallidum.* The inguinal glands were discrete, firm, and slightly enlarged. A 0.3-gram injection of neoarsphenamine was given on March 28 and 31, and bismosol intramuscularly on March 29 and April 1.

On March 31 the patient complained of sore throat. Examination showed the throat slightly red, and the temperature 99.2°. The following morning the temperature rose to 101.4°, and his throat was slightly worse. The right tonsil was inflamed and edematous. Acute tonsillitis treated routinely.

On April 3 the patient was noticed to have a faint maculopapular rubeoliform rash, most prominent on chest, abdomen, back, and flexures. April 4, 1938, no Koplik spots, strawberry tongue, or other evidence of an exanthem was present.

Two days later the rash had spread and was accompanied by a severe pruritis

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involving palms of hands. Olive oil was used locally. Four injections of sodium thiosulphate were given intravenously. Recovery in 6 days.

(*5–1938.*) After exposure on February 19, 1938, this patient developed a typical Hunterian chancre on penis. A darkfield examination was positive for *Treponema pallidum.*

He was given 0.4-gram injections of neoarsphenamine on March 9 and 12 and a 0.5 gram injection on March 16. Twelve hours after the last injection the patient developed a generalized scarlatiniform rash accompanied by acute pharyngitis, tonsillitis, and headache. The temperature was 104°. There was generalized aching and intense itching of affected areas of skin. The rash was a scarlatiniform dermatitis and the reaction was not Herxheimer in type. No specific treatment was given. It is of interest that a few drops of the solution escaped from the vein on the first injection and that a second vein had to be used; the local reaction was very slight. Recovery in 9 days.

(*6–1938.*) This patient was exposed to infection on January 8, 1938, and 3 weeks later eight separate discrete lesions developed on the penis. Repeated darkfield examinations were positive for *Treponema pallidum.* A Kahn blood test was 4-plus.

Arsenical treatment began with a 0.3-gram injection of neoarsphenamine on February 3, followed by a 0.45-gram injection on February 8. As concurrent treatment he was given 0.13-gram intramuscular injections of bismuth salicylate on February 2 and 10.

Five hours after the last injection of neoarsphenamine the patient complained of headache and general malaise. Four hours later his temperature rose to 103°. The following morning he developed nausea and vomited following repeated attempts to give him liquid nourishment. During the evening the temperature rose to 104°.

On February 10, two days after the last injection of neoarsphenamine, a generalized macular rash appeared. The following day the rash showed signs of fading and the temperature fell by lysis. Recovery in 6 days.

(*7–1938.*) This patient was infected on June 11, 1938. Syphilis was diagnosed clinically by the appearance of an ulcer on the lower lip which was about 1 cm. in diameter with hard painless induration on edges and base. A darkfield examination on August 15 was positive for *Treponema pallidum.* A Kahn blood test was 3-plus on August 22.

Arsenical treatment began on August 16, 1938, with a 0.3-gram injection of neoarsphenamine with no untoward after effects. The second injection of neoarsphenamine, 0.6-gram, was given on August 23.

Four days after the second injection the patient developed macular rash, morbilliform in appearance and distribution. Chief complaint was a general skin rash on body, arms, and legs; fever; and headache. The temperature was 103°, pulse 110. Three injections of sodium thiosulphate were given intravenously, a total of 2.5 grams. The skin condition cleared rapidly and the temperature returned to normal 3 days later. Recovery in 4 days.

(*8–1938.*) After exposure to infection on March 14, 1938, this patient developed a primary lesion on penis which was positive for *Treponema pallidum.*

Arsenical treatment began on March 24, 1938, with a 0.3-gram injection of neoarsphenamine, followed by a 0.45-gram injection on March 31.

Twenty-four hours after the last injection the patient was admitted to sick list complaining of headache, constipation, and slight cough. A fine rash, not typical of secondaries, was evident on chest and exposed surfaces of arms. Throat was red with some spots. His temperature was 104°. On the following day physical

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examination revealed temperature 101° and a fine pin-point red skin eruption present on trunk and thighs. Conjunctivae and sclera markedly injected and pharynx slightly injected. By April 12, 1938, all symptoms and rash had subsided under treatment of sodium thiosulphate and alkalies. The following day a syphilologist recommended an empirical injection of 0.01 gram of mapharsen, intravenously, which was given in an effort to determine the patient's reaction to arsenicals and to establish diagnosis. Within 2 hours patient became nauseated, sclera and conjunctivae were injected, and there was elevation of temperature and general malaise. Sodium thiosulphate was given. Recovery in 12 days from onset of first symptoms.

(*9–1938.*) After repeated exposures to infection this patient developed a primary lesion on May 8, 1938. A darkfield examination of the lesion was positive for *Treponema pallidum.* A Kahn blood test was 4-plus. Arsenical treatment began with a 0.3-gram injection of neoarsphenamine on May 10, followed by a 0.4-gram injection on May 14, and a 0.5-gram injection on May 17. Two and one-half hours after the last injection the patient developed headache, malaise, and a temperature of 104°. Examination revealed flushed face, mild injection of pharynx, and enlargement of post cervical glands. Erythema was present over chest and abdomen the following day; temperature 103°. On May 21, four days after last injection, a scarlatiniform rash appeared over chest, abdomen, arms, and legs. Complete recovery in 9 days after onset of symptoms.

It is of interest to note that this patient had a few drops of neoarsphenamine injected subcutaneously at the time of his first injection. Certain observers have mentioned the possibility of subcutaneous leakage causing a sensitivity to subsequent injections.

Mapharsen

(*10–1938.*) There was no diagnosis of syphilis made. In this case physical examination was entirely negative as regards signs of syphilis. Kahn serum reactions were 4-plus on September 23 and September 30, 1935. No diagnosis of syphilis was made but because of strongly positive blood Kahn tests this patient was advised to take antisyphilitic treatment.

From October 7, 1935, to June 16, 1938, he received 31 injections of neoarsphenamine, a total of 22.35 grams, and 39 injections of bismuth, a total of 5.01 grams.

On June 28 the patient was given a 0.04-gram intravenous injection of mapharsen. Two days after the injection he stated that his throat felt swollen, that he experienced difficulty in swallowing, and that his hands had a burning sensation.

Examination on July 5 revealed several large urticarial areas about 2 inches in diameter on the back and shoulders. There was a slight fine dark red papular rash on the back of hands and forearms.

On July 6 examination showed large wheals scattered haphazardly on the skin, surrounded by areas of erythema. These urticarial lesions were most noticeable at pressure points, namely, in the belt line, buttocks, and points of shoulders. There was also some edema and reddening of the skin of the palms of the hands and soles of the feet.

Blood picture

Date	WBC	Segmented	Bands	Lymphs	Monos	Eosins
July 7, 1938	11,100	50	2	46	2	----
July 9, 1938	9,000	66	----	30	2	2
July 11, 1938	12,000	75	----	22	----	3
August 3, 1938	8,000	48	----	46	----	6
August 8, 1938	7,250	56	4	32	2	6
August 11, 1938	9,000	30	----	56	10	4
August 15, 1938	6,900	44	----	52	----	4
August 19, 1938	7,200	62	----	32	----	6

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The patient received a 0.02 gram injection of mapharsen on August 4 with no untoward after effects. However, there was a marked change in his blood count, as noted in the blood picture. The urticarial rash gradually cleared and the blood count returned to normal. Recovery in 51 days.

(*11–1938.*) After exposure to infection on January 26, 1938, this patient developed a penile lesion. A darkfield examination of the lesion was positive for *Treponema pallidum.* A Kahn blood test was 3-plus. He was given a 0.15-gram injection of neoarsphenamine on February 14, followed by 0.3-gram injections on February 16 and 20, and 0.6-gram injections on February 26, March 5, and 12. On March 19 a 0.06-gram injection of mapharsen was administered. Six hours after the injection of mapharsen the patient complained of excruciating pain in his legs, stating that he noticed the pain first ½ hour after the injection of mapharsen. Physical examination revealed erythematous, dime-size macules distributed over arms, neck, and thorax. One gram of sodium thiosulphate was given intravenously. Recovery in 10 hours.

(*12–1938.*) The source and date of infection in this case is unknown. The patient was given a diagnosis of syphilis on November 6, 1934 because of repeated 4-plus Kahn blood tests. He showed no signs of hereditary syphilis and denied venereal infection.

Antiluetic treatment was instituted on November 19, 1934, and from that date until December 31, 1937, the patient was given 61 injections of neoarsphenamine, a total of 35.4 grams. For concurrent treatment he was given 27 cc. of bismosol, and 2.6 grams of bismuth salicylate.

The eighth course of arsenical treatment began on February 24, 1938, with a 0-3-gram injection of neoarsphenamine, followed by 0.6-gram injections on March 2, 9, 17, and 23. On March 30 mapharsen was substituted for neoarsphenamine because of apparent Kahn fast blood and 0.6-gram injections were given on March 30, April 5, 12, and 26. Forty-eight hours after the last injection a macular rash appeared on neck, chest, and forearms. The following day the rash became more confluent, itching and spreading to trunk. Two 1-gram injections of sodium thiosulphate were given intravenously. Recovery in 5 days from onset of symptoms.

Stovarsol

(*13–1938.*) This patient had no syphilitic infection, but was being treated for amebic dysentery with an arsenical compound. On May 30, 1938, a 0.25-gram dose of stovarsol was given orally, followed by 0.75-gram doses daily for 8 days. On the tenth day the dose was decreased to 0.25 gram. No heavy metal was given as concurrent treatment.

After the eighth dose on June 6 the patient felt feverish and complained of headache and malaise. Temperature, 101.6°; pulse, 100; and respirations, 20.

June 7: Temperature ranged from 99.2° to 103.6° accompanied by a severe headache and some conjunctival and pharyngeal injection.

June 8: Temperature was 104° at 6 a. m. and 105° at 10 p. m. Stovarsol was discontinued.

June 9: The patient developed a generalized slightly itching erythematous macular eruption, which had the appearance of a drug rash.

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Blood picture

Date	WBC	RBC	Hgb	Polys	Bands	Segmented	Lymphs	Monos	Eosins	Juveniles
May 21, 1938	8,400		100	62	6	56	30	4	4	
June 7, 1938	10,700			64	19	45	27	7	2	
June 8, 1938	11,900			73	28	42	20	7		3
June 10, 1938	8,100			72	28	40	21	5	2	
June 13, 1938	7,200	4,470,000	95	57	3	54	28	4	11	
June 20, 1938	6,800			43	5	38	50	6	1	
June 28, 1938	6,200			35	4	31	59	6		

Five injections of sodium thiosulphate were given intravenously. The skin condition returned to normal and the temperature fell by lysis. Recovery in 33 days.

SEVERE REACTIONS

The 10 severe reactions occurred after the following number of injections: 2 after the third; 1 after the fifth, sixth, and seventh; 3 after the eighth; 1 after the ninth; and 1 after the first injection of the second course of arsenical treatment. The interval between the injection and appearance of symptoms varied from 6 hours to 8 days. The length of time required for recovery varied from 29 days to 155 days.

NEOARSPHENAMINE

(*14–1938.*) One month following exposure to infection this patient developed a primary lesion in midline of upper lip. A darkfield examination was positive for *Treponema pallidum*. A Kahn blood test was 4-plus. The submaxillary and posterior cervical glands were enlarged. Arsenical treatment began on August 2, 1938, with a 0.3 gram injection of neoarsphenamine, followed by 0.6 gram injections on August 9 and 16. Bismuth salicylate was given as concurrent treatment.

Two days after the last injection of neoarsphenamine the patient noticed that his skin began to itch, especially about ankles and arms. A maculopapular, erythematous type of rash, having the appearance of arsenical dermatitis, appeared at these points and gradually spread over the entire body. There was some weeping from lesions on the legs and ankles. WBC, 8,000; bands, 13; segments, 57; lymphs, 18; eosins, 5; monos, 7. Five 1-gram injections of sodium thisulphate were given intravenously.

September 2, 1938: Rash faded leaving a coppery pigmentation of skin over affected areas. There was desquamation of the areas that were most affected. On October 27 an injection of mapharsen was given with no apparent reaction. Recovery in 29 days.

(*15–1938.*) After exposure to infection on January 3, 1938, this patient developed a hard, indurated chancre on the glans penis. A darkfield examination was positive for *Treponema pallidum*. A Kahn blood test was 4-plus.

From February 19 to April 22, 1938, he received nine injections of neoarsphenamine, a total of 4.8 grams and bismuth salicylate as concurrent treatment. On April 24, two days after the last injection of neoarsphenamine, the patient noticed a slight rash, small red raised spots about the chest, abdomen, and back. He did

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not report this condition until the following day when the rash had spread over the arms and legs. On the following day the rash became more pronounced over the upper part of the body.

The patient did not feel well and had a temperature of 100°. One gram of sodium thiosulphate was given intravenously on April 28. Condition progressively worse; rash more extensive and crustaceous, with a serous exudate. Temperature, 103°; pulse, 110; respirations, 26.

April 29, 1938: A crustaceous serous dermatitis involved the face, neck, upper extremities, and body. The lower extremities were covered with a diffuse, large sized, papular dermatitis. There was a slight to moderate edema of the face, neck, upper body, and arms. WBC, 6,800; RBC, 3,408,000. The edema and skin involvement of the arms made the intravenous administration of sodium thiosulphate impractical. For the same reason no intravenous glucose was given. Fluid intake in 24 hours was 4,360 cc.; output, 2,285 cc.

April 30, 1938: Perspiration and serous exudation were marked, the bed linen becoming soaked shortly after being changed.

May 2, 1938: Patient was transferred to hospital where physical examination revealed a red macular rash over entire surface of the body, in most places forming confluent erythematous patches which had a marked tendency to weep. The skin was generally edematous, more particularly noticeable about the eyelids, lips, and ears. The urine showed a trace of albumin with rare coarse granular casts.

May 6, 1938: Skin much improved by colloidal baths. Continuous septic temperature varying from 100° to 104°.

May 26, 1938: Weeping of skin has subsided. Patient developed an abscess on the right buttock, apparently secondary to bismuth injection, from which approximately 1,000 cc. of foul smelling pus was evacuated.

June 13, 1938: Patient's condition considerably improved and the skin is in much better condition. Abscess is cleaner but is evidencing very little tendency to heal.

June 25, 1938: Exfoliative dermatitis has practically disappeared except for areas of involvement in axilla, cubital, and popliteal spaces.

August 10, 1938: Abscess on hip is healing. However, general condition indicates that patient has not entirely recovered from his arsenical reaction.

September 24, 1938: Patient was discharged to duty this date, with recommendation that antiluetic treatment be continued, avoiding the use of arsenicals. Recovery in 155 days from onset of symptoms.

(*16–1938.*) This patient was exposed to infection on June 25, 1938. Fifteen days later he developed a primary lesion on the penis and lymphadenitis of inguinal gland. A Kahn blood test was 3-plus.

Arsenical treatment began on July 27 with a 0.3-gram injection of neoarsphenamine, followed by 0.45-gram injections on August 3, 10, 17, 24, 31, and September 7, a total of 3.00 grams.

Three days after the last injection the patient complained of mild sore throat and slight rash on forearms and back. Examination revealed conjunctiva and pharynx mildly injected and a fine petechial rash over forearms and back. Temperature 99°. On the following day the petechial rash had extended to the chest, neck, and face. The face was swollen and the eyelids edematous. One gram of sodium thiosulphate was given intravenously. The skin condition gradually terminated by desquamation. Recovery in 40 days.

(*17–1938.*) The source of infection in this case is unknown. The patient (supernumerary female) was given a diagnosis of syphilis because of repeated positive Kahn blood tests.

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She was given 0.45-gram injections of neoarsphenamine on September 23, 1937, and February 23, 1938. A 0.6-gram injection of neoarsphenamine was given on March 2, 1938, and a generalized skin rash, nausea, and dizziness were noted the following morning. Patient reported on March 9 for regular treatment, at which time a macular rash over entire body, markedly swollen face, and puffiness of the feet and ankles were noted. On March 18 numerous small, clear vesicles were noted over entire skin area. Temperature, 102°; pulse, 104; and respirations, 24. WBC, 16,000; segs, 23; bands, 4; monos, 15; lymphs, 56; basos, 2. Icterus index, 8.

Repeated urinalysis showed a trace of albumin and numerous leukocytes. March 22, WBC 8,000; segs, 65; bands, 1; lymphs, 30; monos, 4. The urine remained positive for albumin. The patient received 2 injections of sodium thiosulphate, force fluids, sodium citrate, 15 grains, every 4 hours by mouth, and local applications of cold cream. The skin condition showed steady improvement under treatment. Recovery in 33 days.

(*18–1938.*) The source of infection in this case is unknown. The patient (supernumerary, veteran, World War) was given a diagnosis of syphilis because of positive blood and spinal fluid. From February 22 to April 15, 1938, the patient received 16 intramuscular injections of bismuth salicylate.

Arsenical treatment began on April 19, 1938, with a 0.10-gram injection of neoarsphenamine, followed by a 0.35-gram injection on April 26, and 0.7-gram injections on May 3, 10, and 17. Six hours after the last injection of neoarsphenamine the patient had a slight chill and complained of general malaise. The following day he developed a scarlatiniform rash and a low-grade fever. There was no evidence of jaundice. WBC, 6,800; RBC, 4,280,000. The urine contained 1-plus albumin. An exfoliative dermatitis gradually developed and 1-gram injections of sodium thiosulphate were given on May 18, 19, and 20. Recovery in 43 days.

(*19–1938.*) This patient was given a diagnosis of syphilis on July 15, 1938, because of a positive darkfield examination of a penile lesion and a 4-plus Kahn blood test. Arsenical treatment began with a 0.3-gram injection of neoarsphenamine on July 15, followed by a 0.45-gram injection on July 20, and 0.6-gram injections July 26, August 4, 9, 16, 23, and September 1. Sixteen injections of bismuth salicylate were given as concurrent treatment. Four days after the last injection of neoarsphenamine the patient developed an acute erythema of the skin, with edema of the face and hands. The lesions were characteristic of a neoarsphenamine reaction.

September 8: Edema and inflammation of the skin more severe. WBC, 46,250; segs, 53; bands, 13; eosins, 20; lymphs, 13; monos, 1.

The skin condition developed into a severe exfoliative dermatitis with areas most involved showing serous weeping. The skin condition steadily improved under treatment. Recovery in 98 days.

(*20–1938.*) One month after exposure to infection this patient developed a penile lesion which was positive for *Treponema pallidum.* Arsenical treatment began on August 28, 1938, with a 0.3-gram injection of neoarsphenamine, followed by a 0.45-gram injection on September 1, and 0.5-gram injections on September 13, 21, 26, October 3, 8, and 15. Two days after the last injection of neoarsphenamine the patient developed an itching rash on the arms and legs which he thought was heat rash. The rash, however, increased in severity and extent. Weeping and crusting lesions appeared early. The patient felt generally ill and had a temperature of 103°. Three days later the entire skin surface became edematous and erythematous. Heavy greasy scales and weeping patches were generally present, particularly on the hands and feet. The aural canals almost closed by edema

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and the debris composed of scales and crust. Temperature remained high. WBC, 28,500; segs, 62; bands, 9; eosins, 10; lymphs, 14; monos, 5. RBC, 4,730,000. A severe exfoliative dermatitis developed which gradually improved under treatment. Recovery in 81 days.

(*21–1938.*) This patient was exposed to infection on June 28, 1938, and developed a penile lesion which was positive for *Treponema pallidum*. Because repeated urinalyses showed moderate to large amounts of albumin, casts, and red blood cells, treatment was begun cautiously with bismuth. No arsenical was administered. The urinary findings persisted, so treatment was discontinued pending further study of the kidney condition. In spite of the finding of albumin and casts on a number of examinations it was decided that nephritis did not exist. Arsenical treatment was instituted on August 23, 1938, despite a slight trace of albumin, and continued until October 14, a total of 8 injections of neoarsphenamine (4.05 grams) being administered. Three days after the eighth injection of neoarsphenamine the patient developed an itching skin rash about the abdomen and chest. This condition remained comparatively mild for 1 week when the rash became generalized and excessively itchy. The patient's appetite failed and he felt generally ill. The treatment consisted of sodium thiosulphate, ephedrine and sedatives. The skin was generally dry and roughened by the presence of thickly set small reddish papules. Many areas, particularly on the groins and flexor surfaces of the joints, presented extensive erythematous patches, having a tendency to scale. Bismuth therapy, previously discontinued, was resumed on December 5, 1938. The skin condition gradually improved and the patient was returned to duty with the recommendation that antiluetic treatment consist of alternate courses of bismuth and mercury to limit of tolerance but that the use of arsenicals be avoided. Recovery in 91 days.

Mapharsen

(*22–1938.*) A patient who was exposed to infection on November 30, 1930, developed a primary lesion on shaft of the penis. Darkfield examination was negative due to the patient having placed something on the lesion. A Kahn blood test was 4-plus on February 12, 1931. He was given a diagnosis of syphilis because of the positive Kahn blood test and glandular enlargement. From February 16 to April 23, 1931, the patient received 4.8 grams of neoarsphenamine, and 11 injections of mercury as concurrent treatment. From July 29, 1931 to February 10, 1932, he received 25 injections of mercury salicylate (amount not recorded), and from November 3, 1937 to May 31, 1938, 24 injections of bismuth salicylate, a total of 4.68 grams. The second course of arsenical treatment began with a 0.02 gram injection of mapharsen. Twenty-one hours after the injection of mapharsen the patient developed a chill and urticaria and weeping from an old eczema involving the lower legs.

Examination revealed the face edematous with macular desquamating skin lesions. Exfoliative dermatitis covered the dorsal and palmar surfaces of the hands and the forearms, both elbow joints being involved. There were some areas of moist exfoliative dermatitis on the inner surfaces of both legs. Temperature, 100°; WBC, 14,500. The patient was given 1 gram of sodium thiosulphate intravenously on June 6 and 7. The skin condition terminated by desquamation. Recovery in 58 days.

(*23–1938.*) The source of infection in this case is unknown. A diagnosis of syphilis was made because of a generalized faint macular rash and repeated 4-plus Kahn blood tests. Arsenical treatment began with a 0.3 gram injection of neoarsphenamine on May 17, 1938, followed by a 0.45 gram injection on May 25. The neoarsphenamine injections were discontinued after the second injection

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because patient experienced fever and severe headache following each injection. Treatment was continued with intramuscular injections of bismuth salicylate. On July 19, arsenical treatment was again instituted with a 0.03 gram injection of mapharsen, followed by 0.06 gram injections on July 26, August 2, and 9. Approximately 8 days after the last injection of mapharsen the patient developed a generalized erythematous rash, undoubtedly the result of the mapharsen. The skin condition gradually developed into a generalized exfoliative dermatitis which showed steady improvement under treatment. Recovery in 128 days.

Fatal Reactions

(*24–1938.*) The source of infection in this case is unknown. A patient (supernumerary female) was given a diagnosis of syphilis because of a 3-plus Kahn blood test. Arsenical treatment was instituted and she received 0.45 gram injections of neoarsphenamine on January 26, February 9 and 23, 1938, a 0.6 gram injection on March 2, and two intragluteal injections of bismosol as concurrent treatment. Twenty-four hours after the last injection of neoarsphenamine the patient noticed itching of the skin and a rash on her neck. Two days later she noted that the rash was more extensive and that it gradually became worse. The patient did not report her symptoms or appear for treatment on March 9, as scheduled. About 3 days previous to her admission to the hospital for treatment (March 16) the patient had a generalized rash, general malaise, fever, and severe swelling of the face and extremities. She appeared acutely ill, when admitted to hospital—temperature 102.8°., pulse 96, and respirations 22. There was a rough, raised, red, and weepy rash over the face and body, blotchy in character, with edema of the subcutaneous tissue. The face and ears were swollen and the eyelids were closed by swelling so that she was unrecognizable. There was a serous discharge from the ears and eyes. The extremities were edematous and covered with rash.

March 17, 1938: WBC, 15,400; polys, 92; lymphs, 8; RBC, 5,560,000; Hgb, 102%.

March 19: Urinalysis: Appearance cloudy, amber, reaction, acid; specific gravity, 1.020; albumin, 2 plus; sugar, negative; many white and red blood cells.

March 21: WBC, 15,400; polys, 57; lymphs, 43; RBC, 4,250,000; Hgb, 82%. One gram doses of sodium thiosulphate were administered intravenously each day from March 16 to March 26, a total of 11 grams being given.

March 27: At 7:30 a. m. the patient became cyanotic and dyspnoeic and in spite of two successive injections of coramine she died suddenly at 8 a. m., 25 days after onset of the first symptoms.

(*25–1938.*) This patient was exposed to infection on January 1, 1938, and developed three distinct penile lesions about the coronal sulcus. A darkfield examination on February 8 was positive for *Treponema pallidum*, and a Kahn blood test was 4-plus.

Arsenical treatment began on February 9, 1938 with a 0.3 gram injection of neoarsphenamine, followed by a 0.45 gram injection on February 15, and 0.6 gram injections on February 22 and March 1. Four injections of bismuth salicylate were given as concurrent treatment. Forty-eight hours after the last injection of neoarsphenamine the patient complained of a severe, itching rash. Examination disclosed a generalized, slightly oozing, dermatitis, especially severe on the face, in the flexures, and extremities. Edema of the face and extremities was marked. The temperature was 99.8°.

Urinalysis: Albumin, negative; sugar, slight trace; specific gravity, 1.020; microscopical, negative.

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Because of fever, marked exfoliation, and edema, the patient was hospitalized on March 4. While at the hospital he was given four intravenous injections of sodium thiosulphate. All antiluetic treatment was immediately discontinued at the first signs of arsenical poisoning.

March 7: The patient returned to his ship materially improved.

March 9: At about 5 p. m. the patient did not feel well, appeared feverish, and his temperature was 102.4°. Examination showed considerable exfoliation, more marked about the face and torso, marked edema of the dorsum of forearms and hands, and a harsh, irritating, nonpronounced cough. WBC, 13,800; bands, 12; monos, 3; lymphs, 12; segs, 65; eosins, 3; juveniles, 4; basos, 1.

March 10: A coarse and exaggerated vesicular breathing over the bronchi with subcrepitant rales throughout both lung fields. Temperature, 104°; pulse, 140; and respirations, 40. A consultation was held and it was decided that bronchopneumonia was developing.

The patient died at 5 a. m. on March 11, ten days after the last injection of neoarsphenamine. It is believed that the recent syphilitic infection and the succeeding arsenical poisoning rendered the patient very toxic and the bronchopneumonia proved more severe.

SUMMARY

In 1938 medical officers of the Navy administered 123,176 doses of arsenicals and reported the occurrence of 40 reactions therefrom. Of these reactions more than one-half (25) were arsenical dermatitis; a ratio of one case of dermatitis to 4,927 doses. Of interest in connection with the etiology of arsenical dermatitis is the number of instances in which premonitory signs were noted. These signs are repeated below and serve to indicate the necessity for careful examination and questioning of each patient before administering an arsenical.

Case 3.—Unreported body rash of moist desquamating papules followed the second injection of neoarsphenamine. The rash developed into an erythematous eruption.

Case 8.—A fine pin-point skin eruption followed the second injection of neoarsphenamine. Thirteen days later an injection of mapharsen was given causing nausea and elevation of temperature.

Case 10.—An urticarial rash followed the first injection of mapharsen The next injection, 37 days later caused a marked change in the blood count but no recurrence of rash.

Case 12.—During the eighth course of neoarsphenamine a substitution of mapharsen was made due to apparent Kahn fast blood. A macular rash appeared following the fourth injection of mapharsen.

Case 13.—Headache, general malaise, and elevated temperature followed the eighth dose of stovarsol. An erythematous rash followed the tenth dose given 2 days later.

Case 15.—Unreported body rash followed the ninth injection of neoarsphenamine. Five days later a severe exfoliative dermatitis developed.

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Case 21.—Fever and severe headache followed each of two injections of neoarsphenamine. Seventy-six days later an erythematous rash followed the fourth injection of mapharsen.

COMMUNICABLE DISEASES [1]

TRANSMISSIBLE BY ORAL AND NASAL DISCHARGES

NAVAL TRAINING STATION, NORFOLK, VA.—Admissions for catarrhal fever showed a slight increase in January due to inclement weather. A mild seasonal epidemic was experienced in February, most of the admissions occurring among recruits. There were 109 admissions in January and 330 in February.

NAVAL AIR STATION, SAN DIEGO, CALIF.—A mild epidemic of catarrhal fever prevailed the last part of March, 51 cases being admitted in 9 days. Most of the cases returned to duty after 2 or 3 days' illness.

NAVAL ACADEMY, ANNAPOLIS, MD.—The epidemic of 146 cases of catarrhal fever during the month of January was largely due to climatic conditions. Overheating of midshipmen's living spaces and class rooms plus propinquity of midshipmen with beginning colds to those who were well are considered to have been predisposing factors. This epidemic affected primarily the colored mess attendants in crowded quarters on the U. S. S. *Cumberland*. There were a number of scattered cases among the rest of the enlisted men while approximately one-half of the mess attendants were affected. In spite of measures taken to improve ventilation and to separate the sleeping men as much as possible, the disease ran swiftly through the mess attendants' detachment affecting all who were susceptible within a few days.

NAVAL AIR STATION, ANACOSTIA, D. C.—There was a mild epidemic of catarrhal fever during the month of February with 20 admissions to the sick list.

SUBMARINE BASE, COCO SOLO, CANAL ZONE.—There was an epidemic of catarrhal fever or mild degree of influenza during the month of January. This disease was prevalent in the city of Colon at the time. The epidemic coincides with the visit of the U. S. Fleet and it is possible that this influx of personnel may have been partially responsible. The symptoms lasted only a few days and the epidemic subsided in the course of a week.

U. S. S. S-45.—An outbreak of catarrhal fever acute, involved 33 out of 39 men in the crew and 1 of the 5 officers, 20 of whom were admitted to the sick list. The first case became ill on January 9, the first day of Fleet Exercise V, and at a time when the submarine was operating submerged for a good part of the time. Characteristic symptoms were observed—body aches, pains across the small of the back, mild sore throat, mild cough, and marked malaise. The infection continued to spread until the ship's return to Coco Solo, about 3:00 p. m. on January 14, when 11 men were admitted to the sick list at the dispensary. Eight more men with objective signs of mild throat irritation and temperatures of 99° and 99.2° were admitted to the sick list for isolation purposes to prevent spread to personnel of other submarines nested at the same dock. Thirteen other men, ill for 2 or 3 days during the week, had recovered completely.

Temperature ranged from normal to 104°; WBC, 4,500 to 10,000, with differential from normal to a lymphocytosis of 40 percent; percentage of band forms, 2 to 8 percent; throat smears showed nothing unusual; gram negative bacilli; and occasional gram positive and gram negative cocci.

[1] Extracted from routine and special epidemiological reports received in the Bureau.

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Inspection of the *S–45* revealed the usual submarine living conditions and methods of preparing food. The cause of the rapid spread is considered due to a particularly infectious type of organism attacking personnel when the submarine was operating submerged for the greater part of the time, accentuating the already close and intimate living conditions on board.

The last case was discharged to duty on January 20, 1939.

U. S. S. Brooklyn.—Sixty-two cases of catarrhal fever, acute, were admitted to the sick list between January 4 and 23, 1939, with a total of 1,780 sick days. The greatest number of cases admitted to the sick list on any one day was 21. The longest period on the sick list for any one patient was 6 days, the average time for each patient being 2.87 days.

The patients on admission complained of headache, fever, weakness, cough, and substernal pain, and had an average temperature of 102° and an elevated pulse rate. Physical examination was essentially negative except for mild conjunctival infection and slight reddening of the nasopharyngeal mucous membrane. There was a slight leukocytosis. The lowest white blood count was 8,400, the highest 12,200. The differential count showed a slight shift to the left in the majority of the cases.

Measures taken to control spread of the infection were as follows:

1. Isolation of all cases.
2. Alternate men in each berthing compartment were provided with cots and arrangements made for them to sleep either on deck or in a messing compartment.
3. The crew was encouraged to spend as much time as possible on deck in the sunshine to reduce the opportunities for direct contact infection.
4. The force of the flow of water was increased in all drinking fountains.
5. Frequent check was made on the scullery to see that all mess gear was scrupulously cleaned and properly sterilized.
6. Particular attention was given to maintain the maximum amount of ventilation possible throughout the ship.

U. S. S. Chicago.—There were 19 cases of mild type of influenza, with no pneumonic complications, during the month of January. The disease ran a short course, usually from 3 to 4 days, with good response to routine treatment. It is believed these cases contracted the disease in Colon, Panama, as Panamanian health authorities reported the presence of influenza there. All cases were isolated in the sick bay to prevent further spread of disease.

During the month of February there were 164 cases of influenza on board this vessel. The type of influenza was of a mild nature with no pneumonic complications. However, the majority of the cases were complicated with an acute follicular sore throat. As in January, the disease ran a short course, usually lasting from 3 to 4 days, with good response to routine treatment. All cases were isolated, the forecastle deck, top side, being used as temporary sick quarters during the height of the epidemic.

U. S. S. Houston.—A total of 56 cases of mild acute catarrhal fever were admitted during February, the peak of 24 cases occurring on February 16. An average of 3 to 4 sick days per case was recorded. Slight upper respiratory infection for 1 or 2 days, general malaise, and elevated temperature caused the men to report to the sick bay for treatment. There was no prostration at onset or depression during convalescence. Physical examination in most cases showed mild to moderate rhinitis and pharyngitis, with negative lung findings.

U. S. S. Lexington.—During the month of January and the early part of February 1939, there was a large increase in admissions for acute catarrhal fever, at the time this ship was en route to the Guantanamo-Gonaives area from San Diego, Calif. A total of 106 cases was admitted to the sick list. Several of the

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cases showed marked prostration for 1 to 2 days. The time on the sick list varied from 2 to 9 days with an average of 3.25 days per case.

Typical symptoms were noted—fever, headache, general malaise, variable prostration, etc. Blood counts on the severer cases showed very little if any change in total leukocytes, but there was some variation in the differential counts; increase in band forms and lymphocytes with corresponding decrease in segmented forms.

One case of influenza was admitted to the sick list at the height of the increase in catarrhal fever admissions and remained on the sick list for 10 days. This patient was much sicker than any of the other cases and had marked changes in the white and differential counts. WBC, 3,800; bands, 15; segments, 39; lymphs, 43; and monos, 3. His temperature remained high for 7 days before coming down to normal by lysis. Prostration was very marked.

U. S. S. Boise.—From January 27 to February 6, 1939, inclusive, 7 officers and 82 men were admitted to the sick list with acute catarrhal fever. Approximately twice this number received ambulatory treatment, the criteria for admitting patients being a temperature of 100° or over, or severe symptoms with or without high fever incapacitating patients for duty. The first 11 cases were admitted with the diagnosis catarrhal fever, acute, but when the epidemic nature of the outbreak was recognized subsequent cases were diagnosed as influenza.

The symptoms presented were as follows:

Symptoms	Number	Percentage
Headache	77	86.5
Painful joints	56	62.9
Nausea	29	32.6
Vomiting	10	11.2
Diarrhea	8	9.0
Cough	82	92.1
Chills	20	22.5
Sore throat	31	34.8

Probably the most interesting feature of the outbreak was the large number of patients showing gastro-intestinal symptoms. Practically all patients showed mild inflammation of the upper respiratory tract, but daily chest examination revealed only eight cases in which there were rales in the lungs. One officer developed broncho-pneumonia, but no other case showed complications. Two compartments adjacent to sick bay were taken over and used as wards. Food was prepared in the general mess and served patients in mess gear kept separate and sterilized after each meal.

There was little opportunity to do laboratory work, but all leukocyte counts done were between 4,000 and 10,000, including the case of broncho-pneumonia.

The average number of sick days was 3.5; shortest, 1 day; longest, 10 days.

FOOD POISONING

U. S. S. LEXINGTON

An outbreak of 45 cases of food poisoning, probably due to *S. enteritidis* infection of longusta salad, occurred on board the *U. S. S. Lexington* between 2:00 a. m., January 31, and 8:00 p. m., February 1, 1939. A total of 114 officers and men were exposed. All cases were in wardroom personnel except one, a mess attendant from another mess, who had eaten wardroom lunch on January 31.

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A longusta salad served at lunch, January 30, was the only one food eaten by all affected personnel. It is, therefore, assumed that this was the offending food, although none remained for examination at the time symptoms appeared. Several officers did not eat this salad; and none of these developed symptoms.

The longusta used in the salad were purchased alive on January 27, boiled as soon as brought aboard and placed in chilling room until the morning of January 30, when the salad was prepared. No alteration in appearance or taste was noted in the longusta.

There was marked variation in severity of symptoms, being roughly in inverse proportion to the length of incubation period, which was 12 to 20 hours in the majority of cases but varied from 5 hours in one case to 34 hours in another. All cases showed profuse diarrhea, which rapidly became watery. Most had abdominal cramps, and these were quite marked in some cases. Vomiting and prostration occurred in a few cases. Most cases responded promptly to treatment with castor oil, paregoric, and bismuth subnitrate, remaining on the sick list less than 10 hours. Six cases were retained 24 hours or longer because of persistent diarrhea or weakness. There were 10 cases of recurrence of symptoms on February 3, all showing diarrhea with little or no abdominal cramping and all responding well to treatment.

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STATISTICS

HEALTH OF THE NAVY

The statistics appearing in this summary were compiled from the monthly reports of communicable diseases received in the Bureau for the month of January, February, and March 1939.

ENTIRE NAVY

Year	All diseases	Injuries and poisonings	All causes	Communicable diseases		Venereal diseases
				A	B	
1934	385	67	452	35	116	64
1935	371	67	438	28	85	62
1936	337	49	386	30	140	42
1937	276	36	313	18	98	59
1938	387	46	434	9	128	86
1939	423	47	470	19	168	80
FORCES ASHORE						
1934	621	88	709	76	230	58
1935	491	80	571	54	110	45
1936	518	50	568	59	226	26
1937	312	36	347	34	131	21
1938	447	50	497	14	195	40
1939	487	47	534	10	253	41
FORCES AFLOAT						
1934	271	57	328	15	62	67
1935	312	60	372	16	72	71
1936	229	49	278	13	89	51
1937	256	37	293	8	78	78
1938	353	44	397	6	90	113
1939	390	47	437	24	125	100

Common infectious diseases of the respiratory type.—During the first quarter of 1939 a total of 5,943 cases of the common infections of the respiratory type were recorded for the entire Navy, as compared with 1,202 admissions for the preceding quarter and 4,354 admissions for the first quarter of 1938.

There were 2,948 admissions for these diseases reported by shore stations in the United States, 93 from outlying naval stations and activities, and 2,902 from the forces afloat. The largest number of cases were reported from the following ships and stations:

Ship or station	January	February	March	Total
Naval training station, Norfolk, Va	140	413	243	796
Naval training station, Newport, R. I	132	153	91	376
Naval Academy (midshipmen)	152	133	33	318
Naval training station, Great Lakes, Ill	21	208	55	284
U. S. S. *Chicago*	24	161	4	189
U. S. S. *Ranger*	33	117	10	160
U. S. S. *Lexington*	89	32	9	130
Marine Barracks, Quantico, Va	15	86	25	126
U. S. S. *Boise*	17	90	8	115
U. S. S. *West Virginia*	38	61	5	104
U. S. S. *Louisville*	17	65	19	101
Naval Academy (other than midshipmen)	55	40	6	101
Naval training station, San Diego, Calif	15	15	69	99
U. S. S. *Tennessee*	17	34	32	83
Marine Corps base, San Diego, Calif	21	23	34	78
Naval air station, Pensacola, Fla	25	13	36	74
U. S. S. *Houston*	7	56	6	69
U. S. S. *Northampton*	37	28	2	67
U. S. S. *Brooklyn*	62	1	2	65
U. S. S. *Medusa*	0	61	4	65
U. S. S. *Mississippi*	20	29	12	61
Submarine base, New London, Conn	14	29	13	56
U. S. S. *Oklahoma*	7	11	33	51

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Scarlet fever.—Eight cases of scarlet fever were reported for the quarter—two in February and one in March from the U. S. S. *Chaumont;* one in March from the Navy Yard, Cavite; and in February 2 from the naval training station, Great Lakes, Ill., and one each from the submarine base, New London, Conn., and the fleet air base, Sitka, Alaska.

Chickenpox.—There were 16 cases of chickenpox reported during January, February, and March 1939, as follows:

Ship or station	January	February	March	Total
U. S. S. *Chaumont*	0	3	3	6
U. S. S. *Canopus*	0	1	2	3
Naval air station, Anacostia, D. C.	0	0	1	1
Naval Academy, Annapolis, Md. (other than midshipmen)	1	0	0	1
Naval proving ground, Dahlgren, Va.	0	0	1	1
Navy Yard, Washington, D. C.	1	0	0	1
Submarine base, New London, Conn.	0	0	1	1
Naval training station, Norfolk, Va.	1	0	0	1
U. S. S. *Saratoga*	1	0	0	1

Paratyphoid fever.—An officer, 39 years of age, with 14 1/12 years' service, was admitted on February 22, 1939, to the naval dispensary, Washington, D. C., and transferred to the naval hospital, Washington, D. C., the same day; diagnosis, mild paratyphoid fever "A". He was discharged to duty on April 14. Probable place and source of infection are unknown. Two complete courses of typhoid prophylaxis had been completed, one in August 1920 and one in August 1924.

A boatswain's mate, second class, 29 years of age, with 11 1/12 years' service, was admitted on February 4, 1939, to the U. S. S. *Oahu* with mild paratyphoid fever "A". The place and source of infection are unknown. Two courses of straight typhoid prophylaxis had been completed, one in June 1927 and one in September 1931. The patient was discharged to duty on February 20.

Food poisoning.—Forty-six cases of food poisoning caused by frankfurters occurred on board the U. S. S. *Honolulu* in March.

Two cases of food poisoning due to fish, barracuda, were admitted at the naval radio station, St. Thomas, V. I. The fish was caught about 6:00 p. m., immediately cleaned and brought ashore about 1 hour later. Steaks were cut and thoroughly fried for dinner at the private quarters of a radioman, first class. First indications of illness occurred 4 hours after eating. None of the suspected food was available for examination.

Toxic symptoms from the ingestion of certain fish are common in the Virgin Islands area. Fish that have been implicated are barracuda, amberjack, large king fish, mackerel, and occasionally the bonita. No definite systematic study has been undertaken to determine the nature of the causative agent. Opinions are about equally divided as to whether it is a Salmonella infection or whether it is a definite neuro-toxin. The causative agent is water soluble and thermostabile. Numerous instances of poisoning have been noted in which the individual ate no flesh but drank only a broth prepared by boiling the fish.

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Venereal disease.—The following table of statistical data indicates the frequency of occurrence of venereal diseases during the first quarter of 1939 as compared with the previous quarter (October, November, and December 1938):

U. S. Ship	Admission rate per 1,000		U. S. Ship	Admission rate per 1,000	
	Fourth quarter, 1938	First quarter, 1939		Fourth quarter, 1938	First quarter, 1939
Arizona	68.38	76.41	*Saratoga*	88.09	66.14
Arkansas	96.05	115.38	*Savannah*	88.77	69.24
Astoria	156.98	132.56	*Tennessee*	109.41	110.20
Boise	152.93	146.84	*Texas*	99.27	191.84
Brooklyn	119.24	42.38	*Trenton*	72.43	79.84
California	66.90	55.63	*Tuscaloosa*	76.40	97.56
Chester	68.75	94.79	*Utah*	103.90	63.35
Chicago	77.61	35.53	*Vincennes*	71.64	95.24
Cincinnati	90.29	90.53	*West Virginia*	77.09	51.54
Colorado	106.81	76.43	*Wright*	59.41	209.40
Concord	172.55	189.75	*Wyoming*	141.03	143.82
Detroit	62.28	83.62	*Yorktown*	134.80	80.33
Enterprise	180.95	83.78			
Honolulu	71.14	65.24	*Asiatic Fleet*		
Houston	29.23	117.28	*Alden*	377.95	366.41
Idaho	67.74	28.62	*Asheville*	467.84	510.64
Indianapolis	53.08	80.38	*Augusta*	483.19	369.43
Langley	56.50	38.10	*Barker*	307.69	430.77
Lexington	101.48	40.76	*Bittern*	203.39	0
Louisville	88.19	134.97	*Black Hawk*	386.90	560.12
Maryland	75.93	42.46	*Bulmer*	125.00	94.49
Memphis	24.84	86.96	*Edsall*	93.02	212.12
Milwaukee	26.73	65.04	*J. D. Edwards*	372.09	274.81
Minneapolis	90.91	53.55	*Finch*	137.93	135.59
Mississippi	91.76	51.61	*J. D. Ford*	298.51	539.68
Nashville	100.00	124.35	*Guam*	67.80	482.76
Nevada	126.98	118.96	*Heron*	0	271.19
New Mexico	81.56	77.44	*Isabel*	188.24	254.55
New Orleans	84.08	81.16	*Paul Jones*	300.75	147.06
New York	114.29	81.31	*Luzon*	333.33	260.87
Northampton	61.37	54.87	*Marblehead*	466.52	316.34
Oklahoma	72.80	77.29	*Mindanao*	376.47	326.53
Omaha	143.37	219.47	*Oahu*	262.30	369.23
Pennsylvania	62.94	77.53	*Parrott*	451.13	366.41
Pensacola	90.47	82.72	*Peary*	687.50	360.90
Philadelphia	103.58	111.79	*Pecos*	648.04	432.43
Phoenix	112.39	126.15	*Pigeon*	405.80	405.80
Portland	95.24	64.52	*Pillsbury*	363.64	149.25
Quincy	64.71	123.53	*Pope*	1,085.27	330.58
Raleigh	20.65	121.00	*Sacramento*	511.63	471.79
Ranger	79.70	53.66	*Stewart*	363.64	338.46
Richmond	46.24	22.10	*Tulsa*	942.53	439.56
Salt Lake City	61.73	48.19	*Tutuila*	126.98	312.50
San Francisco	64.43	85.91	*Whipple*	447.76	231.88

MORBIDITY

Summary for the quarter ending March 31, 1939

Average strength	Forces afloat, 93,105		Forces ashore, 47,296		Entire Navy, 140,401	
	Admissions	Rate per 1,000	Admissions	Rate per 1,000	Admissions	Rate per 1,000
All causes	10,181	437.40	6,313	533.91	16,494	469.91
Diseases only	9,085	390.31	5,762	487.31	14,847	422.99
Injuries and poisonings	1,096	47.09	551	46.60	1,647	46.92
Communicable diseases transmissible by oral and nasal discharges (class VIII):						
(A)	552	23.72	123	10.40	675	19.23
(B)	2,902	124.68	2,991	252.96	5,893	167.89
Venereal disease	2,338	100.45	484	40.93	2,822	80.40

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DEATHS

During the first quarter ending March 31, 1939

Cause		Navy			Marine Corps		Nurse Corps	Total
Principal	Secondary or contributory	Officers	Midshipmen	Men	Officers	Men		
Average strength		10,157	2,232	108,561	1,350	17,663	438	140,401
Disease								
Abscess, amebic, liver	Peritonitis, general, acute.			1				1
Abscess, brain	Meningitis, cerebrospinal, acute.			1				1
Adenocarcinoma, colon	None		1					1
Adenocarcinoma, lung	None	1						1
Carcinoma, pancreas	None				1			1
Carcinoma, squamous cell, esophagus.	None	1						1
Carcinoma, stomach	None	1						1
Dilatation, cardiac, acute	Submersion, nonfatal	1						1
Encephalitis, lethargic	Mastoiditis, acute			1				1
Embolism, cerebral	Thrombosis, subclavian artery.			1				1
Hemorrhage, subdural	None					1		1
Influenza	Myocarditis, acute			1				1
Infarction, brain	None			1				1
Myocarditis, chronic	None					2		2
Otitis, media, acute	Abscess, brain	1						1
Pneumonia, broncho-	Nephritis, acute			1				1
Pneumonia, lobar	None	1		2				3
Pneumonia, lobar	Pleurisy, suppurative			1				1
Pneumonia, lobar	Septicemia			1				1
Rheumatic fever	Endocarditis, acute			1				1
Status lymphaticus	None			1				1
Syphilis	Poisoning, therapeutic, acute, neoarsphenamine.					1		1
Syphilis	Poisoning, therapeutic, acute, neoarsphenamine and granulocytopenia, malignant.			1				1
Teratoma, abdomen and testicle.	None					1		1
Thrombosis, coronary artery.	None	6		1				7
Tuberculosis, pulmonary, chronic.	None			3				3
Total for disease		12	1	18	1	5		37
Injuries and poisonings								
Asphyxiation						1		1
Dislocation, cervical vertebrae.	Intraspinal injury			1				1
Drowning	None	1		5				6
Fracture, compound, skull.	None			1		1		2
Fracture, simple, cervical vertebrae.	Intraspinal injury			1				1
Fracture, simple, skull	None			1				1
Injuries, multiple, extreme.	None	1		3				4
Do	Psychoneurosis, hysteria.			1				1
Intracranial injury	None			1				1
Rupture, traumatic, stomach.	Peritonitis, general, acute.			1				1
Strangulation, respiratory	Psychoneurosis, psychasthenia	1						1
Do	None					1		1
Wound, gunshot, chest	None					1		1
Wound, gunshot, head	None			4		1		5
Poisoning, acute, cyanide	None			1				1
Total for injuries and poisonings.		3		20		5		28
Grand total		15	1	38	1	10		65
Annual death rate per 1,000:								
All causes		5.91	1.79	1.40	2.96	2.26		1.85
Disease only		4.73	1.79	.66	2.96	1.13		1.05
Drowning		.39		.18				.17
Poisonings				.04				.03
Other injuries		.79		.52		1.13		.60

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MENTAL AND PHYSICAL QUALIFICATIONS OF RECRUITS

Statistics for first quarter ending March 31, 1939

The following statistics were taken from sanitary reports submitted by naval training stations:

January, February, and March, 1939	U. S. naval training station			
	Norfolk, Va.	Newport, R. I.	Great Lakes, Ill.	San Diego, Calif.
Recruits received during the period	1,290	792	913	531
Recruits appearing before board of medical survey	12	0	7	(a)
Recruits recommended for discharge from the service	11	0	7	(a)
Recruits discharged by reason of medical survey	8	0	6	(a)
Recruits held over pending further observation	2	0	(a)	(a)
Recruits transferred to the hospital for treatment, operation, or further observation for conditions existing prior to enlistment	0	11	(a)	11

[a] Not reported.

The following table was prepared from reports of medical surveys in which disabilities or disease causing the surveys were noted existing prior to enlistment. With certain diseases, survey followed enlistment so rapidly that it would seem that many might have been eliminated in the recruiting office.

Cause of survey	Number of surveys	Cause of survey	Number of surveys
Abscess, periapical	2	Gonococcus infection, urethra	1
Absence, acquired, teeth	4	Hernia, inguinal indirect	1
Acne, vulgaris	5	Hernia, recurrent, after operation	1
Ankylosis, metatarsal-phalangeal	1	Keratitis	1
Anomaly of form, rotation of colon	1	Malocclusion, teeth	2
Arthritis, chronic, joints	1	Metatarsalgia	1
Asthma	1	Migraine	1
Astigmatism	1	Myocarditis, chronic	1
Astigmatism, compound, myopic	1	Myopia	2
Bronchitis, chronic	1	Myositis, chronic	1
Caries, teeth	3	Nephritis, chronic	5
Cicatrix, skin	1	Otitis media, chronic	6
Color, blindness	1	Pes cavus	2
Constitutional psychopatic state, inadequate personality	3	Psychoneurosis, anxity neurosis	1
Deafness, bilateral	3	Psychoneurosis, hysteria	3
Deafness, unilateral	4	Psychoneurosis, neurasthenia	2
Deformity, acquired	4	Psychroneurosis, situational	2
Deformity, congenital	3	Seasickness	2
Dementia praecox	1	Somnambulism	1
Dislocation, articular cartilage	1	Splanchnoptosis	1
Enuresis	8	Sprain, left knee	1
Epilepsy	3	Sprain, sacro-iliac	1
Flat foot	20	Syphilis	3
Foreign body, traumatic, left knee	1	Tic	1
Gastroptosis	1	Ulcer, duodenum	1
		Valvular heart disease, aortic and mitral	1

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